THE

DYER'S ASSISTANT

IN THE

ART OF DYING WOOL

AND

WOOLLEN GOODS.

EXTRACTED FROM

The Philoſophical and Chymical Works of thoſe

MOST EMINENT AUTHORS,

FERGUSON; DUFAY; HELLOT; GEOFFERY; COLBERT;

And that reputable French Dyer,

MONS. DE JULIENNE.

TRANSLATED FROM THE FRENCH.

WITH

ADDITIONS and PRACTICAL EXPERIMENTS.

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By JAMES HAIGH,

Late SILK and MUSLIN DYER, LEEDS.

A NEW EDITION.

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THE PREFACE.

THERE are very few arts ſo extenſive as that of dying; and although thoſe principal commodities, clothing and furniture, receive their chief improvement and value therefrom, it is nevertheleſs very far from being brought to perfection. A long practice, ſound judgment, and great attention, will form a good and expert Dyer. Many Dyers can work with ſucceſs in a number of colours only which depend on each other, and are entirely ignorant of the reſt, or have but a very imperfect idea of them.

A Philoſopher, who ſtudies the art of dying, is in ſome meaſure aſtoniſhed at the multiplicity of new objects which it affords; every ſtep preſents new difficulties and obſcurities, without hopes of any inſtruction from the common workmen, who ſeldom know more than facts and cuſtom. Their manner of explaining themſelves, and their common terms, only afford more darkneſs, which the uncommon and often uſeleſs cir-

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cumſtances of their proceedings render more obſcure.

Before we enter into the particulars of dying wool, it is neceſſary to give an idea of the primary colours, or rather of thoſe which bear this name by the artiſts; for it will appear by reading the celebrated works of Sir Iſaac Newton on Light and Colours, that they bear no affinity with thoſe which the Philoſophers call by that name. They are thus named by the workmen, becauſe, by the nature of the ingredients of which they are compoſed, they are the baſis from whence all others are derived. This diviſion of colours, and the idea which I intend to give of them, are alſo common to the different kinds of dying.

The five primary colours are blue, red, yellow, brown, and black. Each of theſe can furniſh a great number of ſhades, from the lighteſt to the darkeſt; and from the combination of two or more of theſe different ſhades, ariſe all the colours in nature. Colours are oftentimes darkened, or made light, or conſiderably changed, by ingredients that have no colour in themſelves; ſuch are the acid, the alkalis, and the neutral ſalts, lime, urine, arſenic, alum, and ſome others; and in the greateſt part of dyes, the wool and woollen goods are prepared with ſome of theſe ingredients, which of themſelves give little or no colour. It may eaſily be conceived what an infinite variety muſt ariſe from the mixture of theſe different matters, or even from the manner of uſing them; and what attention muſt be given to the minuteſt circumſtances, ſo as perfectly to ſucceed in an art ſo complicated, and in which there are many difficulties.

It is not needful to be very particular in deſcribing the utenſils of a dye-houſe, as they are commonly known; this work being deſigned for the experienced Dyer. A dye-houſe ſhould, however, be erected on a ſpacious plan, roofed over, but admitting a good light, and as nigh as poſſible to a running water, which is very neceſſary, either to prepare the wool before it is dyed, or to waſh it afterwards. The coppers ſhould be ſet at the diſtance of eight or ten feet, and two or more vats for the blue, according to the quantity of work that is to be carried on.

The moſt important point in dying the primitive blue is to ſet the vat properly at work, and conduct her till ſhe is in a ſtate to yield her blue. The ſize of the woad vat is not fixed, as it depends upon neceſſity or pleaſure. A vat containing a hogſhead, or half that quantity, has often been uſed with ſucceſs; but then they muſt be prevented by ſome means from cooling too ſuddenly, otherwiſe theſe ſmall vats will fail.

Another kind of vat is prepared for blue: this is called the indigo vat, becauſe it is the indigo alone that gives it the colour. Thoſe that uſe the woad vat do not commonly uſe the indigo one.

There are two methods of dying wool of any colour; the one is called dying in the great, the other in the leſſer dye. The firſt is done by means of drugs or ingredients that procure a laſting dye, reſiſt the action of the air and ſun, and are not eaſily ſtained by ſharp or corroſive liquors. The contrary happens to colours of the leſſer dye. The air fades them in a ſhort time, more particularly if expoſed to the ſun; moſt liquors ſtain them, ſo as to make them loſe their firſt colour. It is extraordinary that, as there is a method of making all kinds of colours by the great dye, the uſe of the leſſer ſhould be tolerated; but three reaſons make it difficult, if not impoſſible, to prevent this practice.

1ſt, The work is much eaſier. Moſt colours and ſhades which give the greateſt trouble in the great, are eaſily carried on in the leſſer dye.

2d, Moſt colours in the leſſer are more bright and lively than thoſe of the great.

3d, For this reaſon, which carries more weight, the leſſer dye is carried on much cheaper than the great. This is ſufficient to determine ſome men to do all in their power to carry it on in preference to the other. Hence it is that the true knowledge of chymiſtry, to which the art of dying owes its origin, is of ſo much uſe.

It may be obſerved, that all laſting colours are called colours of the great, and the others of the leſſer dye. Sometimes the firſt are called fine, and latter falſe colours; but theſe expreſſions are equivocal, for the fine are ſometimes confounded with the high colours, which are thoſe in whoſe compoſition cochineal enters; therefore, to avoid all obſcurity, I ſhall call the firſt colours of the great, and the latter colours of the leſſer dye.

Experiments, (which are the beſt guides in natural philoſophy as well as arts) plainly ſhow, that the difference of colours, according to the foregoing diſtinction, partly depends on the preparation of the ſubject that is to be dyed, and partly on the choice of the ingredients which are afterwards uſed to give it the colour. I therefore think it may be laid down as a general principle, that all the inviſible proceſs of dying conſiſts in dilating the pores of the body that is to be dyed, and depoſiting therein particles of a foreign matter, which are to be detained by a kind of cement which prevents the ſun or rain from changing them. To make choice of the colouring particles of ſuch a durability that they may be retained, and ſufficiently ſet in the pores of the ſubject opened by the heat of boiling water, then contracted by the cold, and afterwards plaiſtered over with a kind of cement left behind with the ſalts uſed for their preparation, that the pores of the wool or woollen ſtuff ought to be cleanſed, enlarged, cemented, and then contracted, that the colouring atom may be contained in a laſting manner.

Experiments alſo ſhow that there is no colouring ingredient belonging to the great dye which has not more or leſs an aſtringent and precipitant quality. That this is ſufficient to ſeparate the earth of the alum; this earth, joined to the colouring atoms, forms a kind of laque, ſimilar to that uſed by the painters, but infinitely finer. That in bright colours, ſuch as ſcarlet, where alum cannot be uſed, another body muſt be ſubſtituted to ſupply the colouring atoms (block-tin gives this baſis to the ſcarlet dye). When all theſe ſmall atoms of earthy-coloured laque have inſinuated themſelves into the pores of the ſubject that is dilated, the cement which the tartar leaves behind ſerves to maſticate theſe atoms; and laſtly, the contracting of the pores, cauſed by the cold, ſerves to retain them.

It is certain that the colours of the falſe dye have that defect only becauſe the ſubject is not ſufficiently prepared; ſo that the colouring particles being only depoſited on its plain ſurface, it is impoſſible but the leaſt action of the air or ſun muſt deprive them of part, if not of the whole. If a method was diſcovered to give to the colouring parts of dying woods, the neceſſary aſtriction which they require, and if the wool at the ſame time was prepared to receive them, (as it is the red of madder) I am convinced, by thirty experiments, that theſe woods might be made as uſeful in the great, as they have hitherto been in the leſſer dye.

What I have ſaid ſhall be applied in the ſequel of this Treatiſe, where I ſhall ſhow what engaged me to uſe them as general principles.

I ſhould have been glad to have ſeen a work of this ſort, (knowing the great need there is of a chymical underſtanding of this art) ſigned with the name of ſome perſon of diſtinction, to have given it a better face; yet, in defect of that, I was prevailed upon to undertake the tedious taſk. I dare not flatter myſelf to have brought it to its laſt perfection, as arts daily improve, and this in particular; but I hope ſome acknowledgment will be due to me for bringing this matter a little further out of that obſcurity in which it has laid, and for aſſiſting the Dyers in making diſcoveries to help to perfect this moſt uſeful art.

I ſhall now proceed to examine the five primary colours above mentioned, and give the different methods of preparing them after the moſt ſolid and permanent manner.

JAMES HAIGH.

INTRODUCTION.

THE materials of which cloths are made, for the moſt part are naturally of dull and gloomy colours. Garments would conſequently have had a diſagreeable uniformity, if this art had not been found out to remedy it, and vary their ſhades. The accidental bruiſing of fruits or herbs, the effect of rain upon certain earths and minerals might ſuggeſt the firſt hint of the art of dying, and of the materials proper for it. Every climate furniſhes man with ferruginous earths, with boles of all colours, with ſaline and vegetable materials for this art. The difficulty muſt have been to find the art of applying them. But how many trials and eſſays muſt have been made, before they found out the moſt proper methods of applying them to ſtuffs, ſo as to ſtain them with beautiful and laſting colours? In this conſiſts the principal excellence of the Dyer's art, one of the moſt ingenious and difficult which we know.

Dying is performed by means of limes, ſalts, waters, leys, fermentations, maçerations, &c. It is certain that dying is very ancient. The Chineſe pretend that they owe the diſcovery of it to Hoan-ti, one of their firſt ſovereigns.

One of the moſt agreeable effects of the art of dying, is the diverſifying the colours of ſtuffs. There are two ways by which this agreeable variety is produced, either by needle-work with threads of different colours, on an uniform ground, or by making uſe of yarn of different colours in the weaving.

The firſt of theſe inventions is attributed to the Phrygians, a very ancient nation; the laſt to the Babylonians. Many things incline us to think that theſe arts were known even in the times of which we are now treating. The great progreſs theſe arts had made in the days of Moſes, ſuppoſes that they had been diſcovered long before. It appears to me certain, then, that the arts of embroidery or weaving ſtuffs of various colours, were invented in the ages we are now upon. But I ſhall not inſiſt on the manner in which they were then practiſed, as I can ſay nothing ſatisfactory upon that ſubject.

Another art nearly related to that of dying, is that of cleaning and whitening garments, when they have been ſtained and ſullied. Water alone is not ſufficient for this. We muſt communicate to it, by means of powders, aſhes, &c. that deterſive quality which is neceſſary to extract the ſtains which they have contracted. The ancients knew nothing of ſoap, but ſupplied the want of it by various means. Job ſpeaks of waſhing his garments in a pit with the herb borith. This paſſage ſhows that the method of cleaning garments in theſe ages, was by throwing them into a pit full of water, impregnated with ſome kind of aſhes; a method which ſeems to have been very univerſal in theſe firſt times. Homer deſcribes Nauſicaa and her companions waſhing their garments, by treading them with their feet in a pit.

With reſpect to the herb which Job calls borith, I imagine it is ſalworth. This plant is very common in Syria, Judea, Egypt, and Arabia. They burn it, and pour water upon the aſhes. This water becomes impregnated with a very ſtrong lixivial ſalt, proper for taking ſtains or impurities out of wool or cloth.

The Greeks and Romans uſed ſeveral kinds of earths and plants inſtead of ſoap. The ſavages of America make a kind of ſoap-water of certain fruits, with which they waſh their cotton-beds and other ſtuffs.

In Iceland the women make a ley of aſhes and urine. The Perſians employ boles and marls. In many countries they find earths which, diſſolved in water, have the property of cleaning and whitening cloth and linen. All theſe methods might perhaps be practiſed in the primitive ages. The neceſſities of all mankind are much the ſame, and all climates preſent them with nearly the ſame reſources. It is the art of applying them, which diſtinguiſhes polite and civilized nations from ſavages and barbarians.

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THE

DYER's ASSISTANT.

PART I.

CHAP. I.

OF BLUE.

WOOL and woollen ſtuffs of all kinds, are dyed blue without any other preparation than wetting them well in luke-warm water, ſqueezing them well afterwards, or letting them drain: this precaution is neceſſary, that the colour may the more eaſily inſinuate itſelf into the body of the wool, that it may be equally diſperſed throughout; nor is this to be omitted in any kind of colours, whether the ſubject be wool or cloth.

As to wool in the fleece, which is uſed in manufacturing cloth, as well the mixt as other ſorts, and which they are obliged to dye before they are ſpun, they are prepared in another manner, viz. they are ſcoured, and thereby diveſted of the natural fat they had when on the body of the animal *. As this operation is properly the Dyer's, and is indiſpenſable in wool which is to be dyed before it is ſpun, let the colour be what it will, I ſhall give the proper proceſs.

This operation is not every where alike, but this is the method followed in the manufactory of Audly in Normandy, where cloths are moſt beautifully manufactured.

A copper containing twenty pails is uſed for this purpoſe; they put twelve pails of water, and four of urine, (which is generally fermented) the copper is heated, and when the liquor is ſo hot as to bear the hand without ſcalding, ten or twelve pounds of wool, that ſtill continues its natural fat, are put in and left in the copper about a quarter of an hour, ſtirring from time to time with ſticks; it is then taken out and put to drain on a ſcray; from thence it is carried in a large ſquare baſket, and placed in running water, two men ſtirring it to and fro for a conſiderable time with long poles, till it is entirely cleanſed of its fat; then it is taken out and placed in a baſket to drain: while this wool is thus preparing, a like quantity may be put into the copper, and thus proceed till the whole is ſcoured. If the liquor is too much waſted, freſh is to be added, made up of one part urine and three parts water. They generally ſcour a bale of wool at once; if it weighed 250lb. in the fat, it generally loſes 60lb. in ſcouring; but this diminution of weight varies in proportion to the wool being more or leſs ſcoured, and in proportion to the more or leſs fat contained therein. Too much attention cannot be paid to the ſcouring, as it is thereby better diſpoſed for the reception of the dye. The

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* The natural fat adhering to the wool preſerves it in the warehouſe, and alſo from moths.

The fat, which is an oily tranſudation, and ſlightly partaking of the quality of urine retained by the fleece, which is too thick to let it out, is ſoluble in water, conſequently, as water alone could not ſeparate it, a fourth part of urine is put into the copper, which muſt have been kept ſome days, in order to ſeparate its volatile ſalts by fermentation; (I mean that it is neceſſary this urine ſhould begin to acquire a ſtrong ſmell) this volatile ſalt, being an alkali, forms with the fat a kind of ſoap, which is always the reſult of all oils and alkalis whatſoever mixed together. As ſoon as ſoap is formed by the combination of theſe two principles, it becomes ſoluble in water and is conſequently eaſily carried off. A proof that a true ſoap has been formed in this operation, is, that the water which carries it away, whitens as long as any fat is ſeparated from the wool: if there was a ſufficient quantity of fermented urine in the copper, the wool will be well ſcoured; if it was not, all the fat would not be changed into ſoap, and conſequently the wool will remain greaſy. The ſame operation might be performed with fixed alkalis, as with the lee of pot-aſh or pearl-aſhes: but as this lee would not only come dearer than urine, it might alſo damage the wool, if the exact proportion was not applied. I am convinced by ſeveral experiments, that theſe cauſtic ſalts do eaſily deſtroy all animal ſubſtances, as wool, ſilk, &c.

I beg the reader may take notice, that though in the ſequel I do not mention this operation of ſcouring, it is nevertheleſs neceſſary for all wool that is to be dyed before it is ſpun, as alſo that it is neceſſary to wet thoſe that are ſpun, and ſtuffs of all kinds, that the colour may be the more equally diffuſed throughout.

Of the five primary colours mentioned in the Preface, two of them require a preparation given by noncolouring ingredients, which, by the acidity and fineneſs of their earth, diſpoſe the pores of the wool to receive the colour. This is called the preparation; it varies according to the nature of ſhades and colours: the red, the yellow, and the colours derived from them muſt be ſo treated; black muſt have a preparation peculiar to itſelf; blue and brown require none; it is ſufficient that the wool be thoroughly ſcoured and wetted; and even for blue, it ſuffices to dip it into the vat, ſtirring it well, and letting it remain, more or leſs, according as the ground of the colour is wanted. For this reaſon, and alſo that many colours previouſly require a blue ſhade to be given to the wool, I ſhall begin with it, and give thereon the moſt exact rules in my power. It is an eaſy matter to dye wool blue, when the vat is once prepared, but it is not ſo eaſy to prepare the vat, which is the moſt difficult part of the Dyer's art. In all the other proceſſes, it is ſufficient to follow the ſimple operations tranſmitted from maſters to apprentices. Three ingredients are uſed in the blue dye, viz. garden-woad or paſtel, the woad, and the indigo. I ſhall give the preparation of each, beginning with the garden-woad.

CHAP. II.

OF THE GARDEN-WOAD, OR PASTEL-WOAD.

THE garden-woad is a plant cultivated in many parts of Holland and France, and might be in England or Ireland, to the great advantage of the huſbandman; it is made up in bales, generally weighing from one hundred and fifty pounds to two hundred; it reſembles little clods of dried earth, interwoven with the fibres of plants; it is gathered at a proper ſeaſon, and laid up to rot, and then made into ſmall balls to dry. Several circumſtances are to be obſerved in this preparation; on this you may ſee the regulations of Monſ. Colbert on Dyes; the beſt prepared comes from the dioceſe of Alby in France.

The Vat ſet to Work.

A copper, as near as poſſible to the vat is filled with water that has ſtood ſome time, or, if ſuch water is not at hand, a handful of Dyer's woad or hay is added to the water, with eight pounds of cruſt of fat madder. If the old liquor from a vat that has been uſed in dying from madder can be procured, it will ſave the madder, and produce a better effect.

The copper being filled, and the fire lighted about three in the morning, it muſt boil an hour and a quarter, (ſome Dyers boil it from two hours and a half to three; it is then conveyed by a ſpout into the woad vat, in which has been previouſly put a peck of wheaten bran. Whilſt the boiling liquor is emptying into the vat, the balls of woad muſt be put one after another into the vat, that they may be the eaſier broken, raked, and ſtirred; this is to be continued till all the hot liquor from the copper is run into the vat, which, when little more than half full, muſt be covered with cloths ſomewhat larger than its circumference, ſo that it may be covered as cloſe as poſſible, and left in this ſtate for four hours. Then it muſt be aired, that is, uncovered to be raked, and freſh air let into it; and to each bale of woad, a good meaſure of ware flung in; this is a concealed name for lime that has been ſlacked. This meaſure is a kind of wooden ſhovel, which ſerves to meaſure the lime groſsly; it is five inches broad and three inches and a half long, containing near a good handful; the lime being ſcattered in, and the vat well raked, it muſt be again covered, leaving a little ſpace of about four fingers open, to let in air. Four hours after, ſhe muſt be raked, without ſerving her with lime; the cover is then put on, leaving, as before, an opening for the air; in this manner ſhe muſt be let to ſtand for two or three hours. Then ſhe may be raked well again, if ſhe is not yet come to work; that is, if ſhe does not caſt blue at her ſurface, and that ſhe works or ferments ſtill, which may be known by raking and plunging with the flat of the rake in the vat; being well raked, ſhe is to remain ſtill for one hour and a half more, carefully obſerving whether ſhe caſts blue. She is then to be ſerved with water, and the quantity of indigo judged neceſſary is to be put in: it is commonly uſed in a liquid ſtate, the full of a dye-houſe kettle for each bale of woad; the vat being filled within ſix finger-breadths of her brim, is to be raked and covered as before; an hour after filling her with water, ſhe muſt be ſerved with lime, viz. two meaſures of lime for each bale of woad, giving more or leſs according to the quality of the word, and what may be judged it will ſpend or take of lime.

I hope the reader will excuſe my plainneſs; this Treatiſe being wrote for the Dyer, I muſt ſpeak the language he is uſed to; the Philoſopher will eaſily ſubſtitute proper terms, which perhaps the workman would not underſtand. There are kinds of woad readier prepared than others, ſo that general and preciſe rules cannot be given on this head. It muſt alſo be remarked, that the lime is not to be put into the vat till ſhe has been well raked.

The vat being again covered, three hours after a pattern muſt be put in, and kept entirely covered for an hour; it is then taken out to judge if ſhe be fit to work. If ſhe is, the pattern muſt come out green, and on being expoſed a minute to the air, acquire a blue colour. If the vat gives a good green to the pattern, ſhe muſt be raked, ſerved with one or two meaſures of lime, and covered.

Three hours after, ſhe muſt be raked, and ſerved with what lime may be judged neceſſary; ſhe is then to be covered, and one hour and a half after, the vat being pitched or ſettled, a pattern is put in, which muſt remain an hour to ſee the effects of the woad. If the pattern is of a fine green, and that it turns to a deep blue in the air, another muſt be dipt in to be certain of the effect of the vat. If this pattern is deep enough in colour, let the vat be filled up with hot water, or if at hand, with old liquor of madder, and rake her well. Should the vat ſtill want lime, ſerve her with ſuch a quantity as you may judge ſufficient by the ſmell and handling. This done, ſhe muſt be again covered, and one hour after put in your ſtuffs, and make your overture. This is the term uſed for the firſt working of wool or ſtuffs in a new vat.

Marks by which you may know how to conduct a Vat regularly.

A vat is fit to work when the grounds are of a green brown, when it changes, on its being taken out of the vat, when the flurry is of a fine Turkiſh or deep blue, and when the pattern, which has been dipt in it for an hour, comes out of a fine deep graſs green. When ſhe is fit to work, the bever has a good appearance, clear and reddiſh, and the drops and edges that are formed under the rake in lifting up the bever are brown. Examining the appearance of the bever, is lifting up the liquor with the hand or rake, to ſee what colour the liquor of the vat has under its ſurface. The ſediment or grounds muſt change colour (as has been already obſerved) at being taken out of the bever, and muſt grow brown by being expoſed to the external air. The bever or liquor muſt feel neither too rough nor too greaſy, and muſt not ſmell either of lime or lee. Theſe are the diſtinguiſhing marks of a vat that is fit to work.

How to know when a Vat is cracked by too great or too ſmall a Quantity of Lime; Extremes which muſt be avoided.

When more lime has been put in than was ſufficient for the woad, it is eaſily perceived by dipping in a pattern, which, inſtead of turning to a beautiful graſs green, is only daubed with a ſteely green. The grounds do not change, the vat gives ſcarcely any flurry, and the bever has a ſtrong odor of quick lime, or its lees.

This error is rectified by thinning the vat, in which the Dyers differ; ſome uſe tartar, others bran, of which they throw a buſhel into the vat, more or leſs in proportion to the quantity of lime uſed, others a pail of urine. In ſome places a large iron chafing-diſh is made uſe of, long enough to reach from the ground to the top of the vat, this chafing-diſh or furnace has a grate at a foot diſtance from its bottom, and a funnel coming from under this grate, and aſcending to the top of the chafing-diſh, which is to give air to, and kindle the coals which are placed on the grate. This furnace is ſunk in the vat, near to the ſurface of the grounds, ſo as not to touch them, and is faſtened with iron bars to prevent its riſing. By this method the lime is raiſed to the ſurface of the liquor, which gives an opportunity to take off with a ſieve what is thought ſuperfluous; but when this is taken out, the neceſſary quantity of ware muſt be carefully reſtored to the vat. Others again thin the vat with pearl aſhes, or tartar boiled in ſtale urine; but the beſt cure, when ſhe is too hard, is, to put in bran and madder at diſcretion; and if ſhe be but a little too hard, it will ſuffice to let her remain quiet four, five, or ſix hours, or more, putting in only two hats full of bran and three or four pounds of madder, which are to be lightly ſtrewed on the vat, after which it is to be covered. Four or five hours after, ſhe is to be raked and plunged, and according to the colour, that the flurry which ariſes from this motion, aſſumes and imprints on the whole liquor, a freſh proof is made by putting in a pattern.

If ſhe is cracked, and caſts blue only when ſhe is cold, ſhe muſt be left undiſturbed, ſometimes whole days without raking; when ſhe begins to ſtrike a tolerable pattern, her liquor muſt be reheated or warmed; then commonly, the lime, which ſeemed to have loſt all power to excite a fermentation, acquires new ſtrength, and prevents the vat from yielding its dye ſo ſoon. If ſhe is to be haſtened, ſome bran and madder are to be thrown on, as alſo one or two baſkets of new woad, which helps the liquor that has been reheated to ſpend its lime.

Care muſt be taken to put patterns in each hour, in order to judge, by the green colour which they acquire, how the lime is worked on. By theſe trials ſhe may be conducted with more exactneſs,

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for when once a vat is cracked, by too great or too ſmall a quantity of lime, ſhe is brought to bear with much more difficulty. If while you are endeavouring to bring her to work, the bever grows a little too cold, it muſt be heated by taking off ſome of the clear, and inſtead thereof, adding ſome warm water; for when the bever is cold, the woad ſpends little or no lime; when it is too hot, it retards the action of the woad, and prevents it from ſpending the lime; therefore it is better to wait a little, than to haſten the vats to come to work when they are cracked. A vat is known not to have been ſufficiently ſerved with lime, and that ſhe is cracked, when the bever gives no flurry, but inſtead thereof gives only a ſcum, and when ſhe is plunged or raked, ſhe only works, ferments and hiſſes, (this noiſe is made by a great number of air bubbles that burſt as ſoon as they form) the liquor has alſo the ſmell of a common ſewer or ſink, or rotten eggs; it is harſh and dry to the touch: the grounds when taken out do not change, which generally happens when a vat is cracked for want of lime. This accident is chiefly to be apprehended when a vat is opened and a dip made in her; for if her ſtate has not been looked into, both in regard to the ſmell as well as raking and plunging, and that the ſtuffs be imprudently put in when the woad has ſpent its lime, it is to be feared the vat may be loſt; for the ſtuffs being put in, the ſmall quantity of lime that ſtill remains in a ſtate to act, ſticks to them, the bever is diveſted of it, and the ſtuffs only blotted; theſe muſt be immediately taken out, and a quick remedy applied to the vat, to preſerve the remaining part of the dye, which is done by putting in three or four meaſures of lime, more or leſs, according as the vat is cracked, and that without raking her bottom.

It is alſo to be obſerved, that if in raking and plunging the fermentation ceaſes, and the bad ſmell change, it is then to be ſuppoſed that the bever or liquor alone has ſuffered, and that the grounds are not yet in want. When the fermentation is in part or totally abated, and the bever has a ſmell of lime, and feels ſoft to the touch, the vat is to be covered and left at reſt; and if the flurry ſtill remains on the vat an hour and a half, a pattern is to be put in, which muſt be taken out one hour after, and you are to be guided according to the green ground it will take. But generally vats that are thus cracked, are not ſo ſoon brought to a ſtate fit for dying.

The Opening of the Vat.

The vat being come to work, the croſs muſt be let down, and about thirty ells of cloth, or the equivalent of its weight of wool well ſcoured, (which is firſt intended to be dyed of a Perſian blue to make a black afterwards) having returned this ſtirring ſeveral times, which muſt have always been covered with the liquor, the cloth muſt be twiſted on the rings faſtened to the jack at the top of the vat; if it be wool, it is to be dipt with a net, which will ſerve to wring it: the cloth muſt be opened by its lifts to air it, and to cool the green, that is, to make it loſe the green colour it had coming out of the vat, and take the blue. If this cloth or wool was not deep enough for a mazarine blue by the firſt dipping, it muſt get another, by returning into the vat the end of the piece of cloth which firſt came out; and according to the ſtrength of the woad, you muſt give to this ſtriking two or three returns, as may be thought neceſſary for the intenſity of the blue required. If the woad be good,

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ſuch as the true L'Auragais is commonly, after taking out the firſt ſtirring, a ſecond may be put in at this firſt opening of the vat. After making this opening, which is alſo called the firſt raking, the vat is to be again raked, and ſerved with lime at diſcretion, obſerving that it has the ſmell and touch conformable to what has been laid down before, and taking notice, that in proportion as the dye diminiſhes, ſo does the ſtrength of the woad.

If the vat be in good order at the firſt opening, three or four ſtirrings may be made, and the next day, two or three more, only obſerving not to hurry her, or to work her as ſtrong as at firſt. That the vat may turn to as much profit as poſſible for the ſhades of blue; firſt, all ſtuffs intended to be black, are dyed; then the king's blue; after theſe the green brown: the violets and Turkiſh blues are commonly done in the laſt rakings of the ſecond day of the opening. The third day, if the vat appears much diminiſhed, ſhe muſt be filled with hot water within four inches of the brim. This is called filling the vat.

The latter end of the week, the light blues are made, and on Saturday night, having raked the vat, ſhe is to be ſerved a little more than the preceding day, that ſhe may keep till Monday.

Monday morning the bever is put on the fire, by paſſing it from the vat into the copper by a trough, which reſts on both; this clear bever is emptied to the grounds, and when it is ready to boil it muſt be returned into the vat, raking the grounds, as the hot liquor falls from the trough; at the ſame time may be added a kettleful of prepared indigo.

When the vat is filled within four inches of the brim, and well raked, ſhe muſt be covered, and two hours after a pattern put in, which muſt remain not more than an hour; lime muſt be added according to the ſhade of the green, which this proof pattern ſhall have taken, and at the expiration of an hour or two, if the vat has not ſuffered, the ſtuff is to be put in; having conducted it between two waters for about half an hour, it is wrung, and a dip is again given to it, as was done in the new vat. This vat heated again, is conducted in the ſame manner, that is, three rakings are made the firſt day, obſerving at each raking, whether ſhe wants lime; for in this caſe, the quantity judged neceſſary muſt be given.

Blue made of woad alone, according to the opinion of ſome perſons prejudiced in the favour of old cuſtoms, is much better than that which the woad gives with the addition of indigo. But then this blue would be much dearer, becauſe woad gives much leſs dye than indigo, and it has been found by repeated experience, that four pounds of fine indigo from Guatimala, produced as much as a bale of Albigeois woad or paſtel; and five pounds as much as a bale from L'Auragais, which generally weighs two hundred and ten pounds. So the uſing of the indigo with the woad is a great ſaving, as one vat with indigo ſhall dye as much as three without it.

Indigo is generally put into new vats after the woad yields its blue, and a quarter or half after ſhe is to be ſerved with lime; as this ſolution of indigo is already impregnated with ſome of its diſſolution, the lime muſt be given with a more ſparing hand than where the woad is uſed alone. At the re-heating, the indigo is put in on Saturday night, that it may incorporate with the bever, and that it may ſerve as garniſh by its lime. The indigo that is brought from Guatimala in America is the beſt; it is brought over in the ſhape of ſmall ſtones, and of a deep blue; it muſt be of a deep violet colour within, and when rubbed on the nail, have a copper hue; the lighteſt is the beſt. It is neceſſary to obſerve, that for the better conducting of a woad vat, and to prevent accidents, a manufacturer ought to have a good woadman, this is the name given to the Journeyman Dyer, whoſe principal buſineſs is to conduct the woad, practice has taught him more than this treatiſe can furniſh.

I ſhall make ſome reflections neceſſary to attain a more perfect knowledge of this proceſs. The woad vat muſt never be re-heated but when fit for working; that is, ſhe muſt have neither too much nor too little lime, but be in ſuch a ſtate as only to want heating to come to work. It is known ſhe has too much lime (as has been before obſerved) by the quick ſmell; on the contrary, a want is known by the ſweetiſh ſmell, and by the ſcum which riſes on the ſurface by raking, being of a pale blue.

Care muſt be taken when a vat is intended to be re-heated, not to ſerve her with lime in the evening, (unleſs in great want of it) for if ſhe was too much ſerved with it, ſhe might next day be too hard, as the Dyers term it; for by heating her again, a greater action is given to the lime, and makes her ſpend it the quicker. Freſh indigo is commonly put into the vat, each time ſhe is re-heated, in proportion to the quantity to be dyed. It would be needleſs to put in any, if there was but little work to do, or only light colours wanted. It was not permitted by the ancient regulations of France, to put more than ſix pounds of indigo to each bale of woad, becauſe the colour of the indigo was thought not laſting, and that it was only the great quantity of woad which could ſecure and render it good; but it is now aſcertained, both by the experiments of Monſieur Dufay, and thoſe which I have ſince made, that the colour of indigo, even uſed alone, is full as good, and reſiſts as much the action of the air, ſun, and rain, as that of paſtel or woad.

When a vat has been heated two or three times, and a good part has been worked off, the ſame liquor is often preſerved, but part of the grounds are taken out, which is replaced by new woad; (this is called vamping); the quantity cannot be preſcribed on this occaſion, for it depends upon the work the Dyer has to do. Practice will teach all that can be wiſhed for on this head. There are Dyers who preſerve liquor in their vats ſeveral years, renewing them with woad and indigo in proportion as they work them; others empty the vat entirely, and change the liquor when the vat has been heated ſix or ſeven times, and that ſhe gives no more dye. A ſeries of practice alone will ſhow which of theſe is preferable. It is however more reaſonable to think, that by renewing it now and then, more lively and beautiful colours may be obtained, and the beſt Dyers follow this method.

In Holland they have vats which do not require to be ſo often heated. Mr. Van Robbais had ſome of theſe made ſome years ſince for their royal manufactory at Abbeville. The upper parts of theſe vats, to the height of three feet, are of copper, and the reſt lead: They are alſo ſurrounded with a ſmall brick wall, at ſeven or eight inches from the copper; in this interval embers are put, which keep up the heat of the vat a long time, ſo that ſhe remains ſeveral days together in a condition to be worked, without the trouble of heating her over again. Theſe vats are much more coſtly than the others, but they are very convenient, eſpecially for the dipping of very light colours; becauſe the vat is always fit to work, though ſhe be very weak; this is not the caſe of the others, which generally make the colour a great deal deeper than required, unleſs they are ſet to cool conſiderably, and then it happens that the colour is not ſo good, nor has it the ſame brightneſs. To make theſe light colours in common vats, it is better to work ſome purpoſely that are ſtrong with woad and weak of indigo; ſuch give their colours ſlower, and light colours are made with greater eaſe.

As to the vats made after the Dutch faſhion, and which have already been mentioned, the four which Mr. Van Robbais has in his manufactory, are ſix feet in depth, of which three feet and a half in the upper part are copper, and the two feet and a half of the bottom are lead. The diameter at the bottom is four feet and a half, and that at the top five feet four inches.

To return to the obſervations on heating the common vats. If the vat was heated when cracked, that is, when ſhe has not quite lime enough, ſhe would turn in the heating without being perceived, and perchance be entirely loſt, as the heat would ſoon finiſh the ſpending of the lime, which was in too ſmall a quantity. If this is perceived in time, it muſt be helped by pouring it back into the vat without more heating; then feed her with lime, and not heat her till ſhe is come to work.

On the re-heating, ſome of the grounds muſt be put into the copper with the liquor or bever; and great care muſt be taken not to boil it, becauſe the volatile neceſſary in this operation would evaporate. There are ſome Dyers, who, in heating their vats, do not put in the indigo immediately after the liquor is poured from the copper into the vat, but wait ſome hours till they ſee her come to work: this they do as a precaution, leſt the vat ſhould fail, and the indigo be loſt; but by this method, the indigo does not ſo freely yield its colour, as they are obliged to work her as ſoon as ſhe is fit, that ſhe may not cool, ſo that the indigo, not being entirely diſſolved, nor altogether incorporated, has no effect. It is therefore better to put it into the vat at the ſame time the liquor is caſt in, and rake her well after. If the vat is heated over again without her coming to work, ſhe muſt not be ſcummed as in the common heatings, as the indigo would be carried off thereby, whereas, when ſhe has worked, this ſcum is formed of the earthy part of the indigo and woad, united with a portion of lime.

When too much lime is put into a vat, you muſt wait for her till ſuch time as ſhe has ſpent it, or it may be accelerated by heating it, or by putting in ingredients which deſtroy in part the action of the lime, ſuch as tartar, vinegar, honey, bran, ſome mineral acid, or any matter that will become ſour; but all theſe correctors wear out the dye of the indigo and woad, ſo that the beſt method is, to let it ſpend of its own accord. A vat is not commonly fed with lime, but on the firſt, ſecond, and ſometimes the third day, and it is alſo remarked, not to dip the violets, purples, or any other wool or ſtuffs which have previouſly a colour that may be eaſily damaged; the ſucceeding day after its being fed with lime, as it is then too active, it dulls the firſt colour; the fifth or ſixth day the crimſon may be dipt to give them a violet, and the yellows for green; following this rule, the colours will always be bright.

When a vat has been re-heated, ſhe muſt come to work before ſhe is ſerved with lime; if this was done a little too ſoon, ſhe would be cracked; the ſame thing would happen if ſome of the grounds were put into the copper. The moſt effectual method in this caſe is to let her reſt before ſhe is worked, until ſhe comes to, which often happens in two, three, or four hours, and ſometimes a day.

By uſing light or weak lime, ſhe grows too hard; becauſe this light lime remains in the liquor, and does not incorporate with the grounds. This is known by the ſtrong ſmell of the liquor, and on the contrary the grounds have a ſweetiſh ſmell, whereas the ſmell ought to be equal in both. The beſt way then is, to let it ſpend itſelf, by raking her often, in order to mix the lime with the grounds, until the ſmell of the vat is reſtored, and the flurry becomes blue.

A woad vat may be ſet without the addition of indigo, but then ſhe yields but little colour, and only dyes a ſmall quantity of wool or ſtuffs; for one pound of indigo, as has already been obſerved, affords as much dye as fifteen or ſixteen pounds of woad. I ſet one of this kind to try the qualities of woad by itſelf, and I could not find that indigo was any way inferior to it, either for the beauty or ſolidity of the colour. As lime is alway suſed, and ſometimes ſour liquors, in the ſetting of a vat, this is the proper place to ſpeak of their preparation.

Preparation of Lime.

That the lime may be properly ſlacked for the Dyer's uſe, ſeveral pieces are immerſed in water, one after another, and when each has remained till it begins to crackle, they are taken out to put in others, and after this manner they are caſt into an empty veſſel, where the lime finiſhes ſlacking, and reduces itſelf to powder, conſiderably augmenting its bulk; it is afterwards ſifted through a canvas, and kept in a dry hogſhead.

Sour liquors are not only neceſſary in ſome circumſtances of ſetting a woad vat, but alſo in ſome of the preparations given to wool and ſtuffs previous to their being dyed; they are prepared after the following manner.

Preparation of ſour Liquors.

A copper of the ſize required is filled with river water, and when it boils, it is flung into a hogſhead, where a ſufficient quantity of bran has been put, and ſtirred with a ſtick three or four times a-day. The proportion of bran and water is not very material; I have made a good liquor by putting three buſhels of bran into a veſſel containing two hundred and fourſcore quarts. Four or five days after, this water becomes ſour, and conſequently fit for uſe in all caſes, where it will not be detrimental to the preparations of wool that are independent of dying.

For it may happen, that wool in the fleece which has been dyed in a liquor where too great a quantity of ſour water has been put, will be harder to ſpin, as the ſediment of the bran forms a ſort of ſtarch that glues the fibres of the wool, and prevents their forming an even thread. I muſt here take notice of the bad cuſtom of letting ſour liquors remain in copper-veſſels, as I have ſeen in ſome eminent dye-houſes; for this liquor being an acid, corrodes the copper, and if it remains long enough to take in a portion of this metal, it will cauſe a defect both in the dye and in the quality of the ſtuff: in the dye, becauſe the diſſolved copper gives a greeniſh caſt; in the quality of the ſtuff, becauſe the copper diſſolved preys on all animal ſubſtances. The Dyers are often ignorant of the cauſe of theſe defects.

I flatter myſelf to have omitted no eſſential point on the woad vat: if any difficulties or accidents, which I have mentioned, are not found in the practice they are not conſiderable, and an eaſy remedy will be found by thoſe who make themſelves familiar with the working part.

The readers who have no idea of this work, may think me too prolix, and find repetitions; but thoſe who intend to make uſe of what I have taught in this chapter, will perhaps reproach me for not having ſaid enough on the ſubject.

Thoſe that read this chapter with attention, will not be ſurprized that the maſter-piece for apprentices to Dyers of the great dye, is, to ſet the woad vat and work her.

CHAP. III.

OF THE FIELD WOAD VAT.

I HAVE but little to ſay on this woad vat, different from that which has been related of the paſtel or garden woad. The woad is a plant cultivated in Normandy, and prepared after the ſame manner the garden woad is in Languedoc. The method of cultivating it may be ſeen in the French "General Inſtructions on Dyes," of the 28th of March, 1671, from the article 259 to 288, where it treats of the culture and preparation of the paſtel and woad. The woad vat is ſet at work after the ſame manner as that of paſtel; all the difference is that it has leſs ſtrength and yields leſs dye. There follows a deſcription of the woad vat, which I carried on in ſmall, and in a bath heat ſimilar to that of the paſtel in the foregoing chapter.

I placed in a copper a ſmall veſſel containing fifty quarts, and filled two-thirds with a liquor made of river water, one ounce of madder, and a little weld, putting in at the ſame time a good handful of wheaten bran and five pounds of woad. The vat was well raked and covered; it was then five in the evening; it was again raked at ſeven, nine, twelve, two, and four o'clock; the woad was then working, that is, the vat was ſlowly coming to work, as I have already related of that of the paſtel.

Pretty large air bubbles formed themſelves, but in a ſmall quantity, and had ſcarcely any colour. She was then ſerved with two ounces of lime and raked. At five o'clock a pattern was put in; which was taken out at ſix, raking her; this pattern began to have ſome colour; another was put in at ſeven, at eight ſhe was raked, and the pattern came out pretty bright; an ounce of indigo was then put in; at nine another pattern, at ten ſhe was raked, and one ounce of lime was added, becauſe ſhe began to have a ſweetiſh ſmell; at eleven a pattern, at twelve ſhe was raked; it was thus continued till five, then three ounces of indigo were put in, at ſix a pattern, at ſeven ſhe was raked. It would then have been proper to have ſerved her with water, as ſhe was at that time perfectly come to work, the pattern that was taken out being very green, and turning of a bright blue. But beſides that I was fatigued, having ſat up the whole night, I choſe rather to put her back to the next day, to ſee her effect by day-light; and for that purpoſe, I put one ounce of lime, which kept her up till nine in the morning: from time to time patterns were put in, the laſt that was taken out was very beautiful; ſhe was ſerved with a liquor compoſed of water, and a ſmall handful of bran. She was raked, and patterns put in from hour to hour; at five ſhe was come to work; ſhe was afterwards ſerved with lime, and raked to preſerve her till ſhe was to be re-heated.

Some time after I ſet another with the woad alone without indigo, that I might be able to judge of the laſting of the dye of the woad, which, upon trial, I found to be as good as the paſtel or garden woad. Thus all the ſuperiority the paſtel has on the woad, is, that the latter yields leſs dye than the former.

The little varieties that may be obſerved in ſetting theſe different vats at work, prove, that there are many circumſtances in theſe proceſſes that are not abſolutely neceſſary. It appears to me, that the only important point, and that to which the greateſt attention is to be given, is, in the conducting the fermentation with care, and not to ſerve her with lime, but when judged neceſſary by the indications I have laid down. As to the indigo being put in at twice, or altogether, a little ſooner or later, it appears very indifferent. The ſame may be ſaid of the weld, which I made uſe of twice, and ſuppreſſed the two other times, and of pearl-aſhes, which I added in a ſmall quantity in the ſmall paſtel vat, and ſuppreſſed in the woad vat. In ſhort, I believe, and it appears to me to a demonſtration, that the greateſt regard is to be had to the proper diſtribution of the lime, throughout the whole courſe of the working of the vats, either to ſet them at work, or to re-heat them. I muſt alſo add, that when a woad vat is ſet to work, ſhe cannot be too often inſpected into to know her ſtate; for if there are ſome that are backward (which is attributed to the weakneſs of the woad) there are alſo others that very quickly come to work. I have ſeen a middling one of ſeventy pounds of woad, poiſoned; becauſe the woad man neglected to inſpect her as often as ſhe required, and ſhe had been two hours fit to work before he diſcovered it; the grounds were entirely come up to the ſurface of the liquor, and the whole had a very ſour ſmell; it was not poſſible to bring her back, and they were obliged to fling her away, as ſhe would in a ſhort time have contracted a fœtid ſmell. The retarding of the action of the vat may alſo proceed from the temperature of the air; for the vat cools a great deal ſooner in winter than in ſummer; therefore it becomes neceſſary to watch it attentively, though commonly they are fourteen or fifteen hours before they come to work.

I ſhall endeavour to explain, in the ſequel, how the colouring part of this ingredient, ſo neceſſary in dying, diſplays itſelf; but I muſt firſt of all ſpeak of vats which are prepared from indigo.

CHAP. IV.

THE INDIGO VAT.

Proceſs of making the INDIGO *in* AMERICA.

INDIGO is the fecula of a plant named *nill* or *anil*; to make it, three vats are placed the one over the other, in form of a caſcade; in the firſt, called the ſteeper, the plant is put in with its leaves, bark, and flowers *, and filled with water; ſome time after, the whole ferments, the water grows intenſely hot, thickens, and becomes of a blue colour bordering on the violet; the plant, according to the opinion of ſome, depoſing all its ſalts, and, according to others, all its ſubſtance. In this ſtate, the cocks of the ſteeper are turned, and all the water let out ſtained with the colouring parts of the plant into the ſecond, called the beater; becauſe this water is beat by a mill or machine that has long ſticks, to condenſe the ſubſtance of the indigo, and precipitate it to the bottom. By this means the water becomes clear and colourleſs, like common water; then the cocks are turned, that the water may run off from the ſurface of the blue ſediment; after which, other cocks are turned that are at the bottom, that all the fecula may fall into the third vat, called the repoſer; for it is there the indigo remains to dry; it is then taken out to be made into cakes, &c. See, on this ſubject, *Hiſtoire des Antilles, pare le Pere Labat.*

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* In the village of Sarguſſa, near the town of Amadabat, the Indians only uſe the leaves of the anil; they fling away the reſt of the plant. The beſt indigo comes from thence.

At Pondicherry, on the coaſt of Coromandel, there are two kinds of indigo, the one a great deal finer than the other; the beſt is ſeldom uſed but to luſtre their ſilks, the inferior in dying. They augment in price according to their quality; there is ſome which coſt from 15 pagodas the bar (which weighs 48 pounds) to 200 pagodas. The moſt beautiful is prepared nigh Agra. There is alſo a very good kind that comes from Maſilupatan and Ayanon, where the Eaſt-India Company have a factory. At Chandernagor it is called nill when it is prepared and cut to pieces. The indigo of Java is the beſt of all; it is alſo the deareſt, and conſequently few Dyers uſe it. Good indigo ought to be ſo light as to float on the water; the more it ſinks, the more it may be ſuſpected of being adulterated by a mixture of earth, cinders, or pounded ſlates. It muſt be of a deep blue, bordering on the violet, brilliant, lively, and ſhining; it muſt be finer within, and appear of a ſhining hue. Its goodneſs is tried by diſſolving it in a glaſs of water; if it be unmixed and well prepared, it will diſſolve entirely; if ſophiſticated, the foreign matter will ſink to the bottom. Another method of trying it is by burning; good indigo burns entirely away, and when adulterated, the mixture remains after the indigo is conſumed.

Powdered indigo is much more ſubject to adulteration than that which is in cakes: for it is a difficult matter that ſand, powdered ſlates, &c. ſhould unite ſo as not to form together in different places layers of different matters; and, in this caſe, by breaking the lump indigo, it is eaſily diſcovered.

Method of working the Indigo Vat.

There are ſeveral methods of preparing the indigo vat; I tried all thoſe I knew, and they all ſucceeded. I ſhall deſcribe them after the moſt exact manner, beginning with that which is the moſt in uſe, and almoſt the only one known at Paris.

It is a vat which is about five feet in height, two feet diameter, and becomes narrow towards the bottom; ſhe is ſurrounded with a wall that leaves a ſpace round her, which ſerves to hold embers. In a vat of this ſize, two pounds of indigo may at leaſt be uſed, and five or ſix for the greateſt proportion. To ſet a vat of two pounds of indigo in ſuch a veſſel that may contain about fourſcore quarts, about ſixty quarts of river water are ſet to boil in a copper for the ſpace of half an hour, with two pounds of pearl aſhes, two ounces of madder, and a handful of bran; during this, the indigo is prepared after the following manner:

Two pounds of it are weighed out, and caſt into a pail of cold water to ſeparate the earthy parts. The water is afterwards poured off by inclination, and the indigo well ground; a little warm water is put into it, ſhaking it from ſide to ſide; it is poured by inclination into another veſſel; what remains is ſtill ground, and freſh water put in to carry off the fineſt parts, and thus continued till all the indigo is reduced into a powder, fine enough to be raiſed by the water. This is all the preparation it undergoes. Then the liquor which has boiled in the copper with the grounds are poured into the high and narrow vat, as likewiſe the indigo; the whole is then raked with a ſmall rake, the vat is covered, and embers placed round her. If this work was begun in the afternoon, a few embers are added at night; the ſame is repeated the next day morning and night. The vat is alſo lightly raked twice the ſecond day; the third day, the embers are continued to be put round, to keep up the heat of the vat; ſhe is raked twice in the day: about this time, a ſhining copper-coloured ſkin begins to appear on the ſurface of the liquor, and appears as if it was broken or cracked in ſeveral places. The fourth day, by continuing the fire, this ſkin or pelicle is more formed and cloſer; the flurry, which riſes in raking the vat, appears, and the liquor becomes of a deep green.

When the liquor is in this ſtate, it is a ſign that it is time to fill the vat. For this purpoſe a freſh liquor is made, by putting into a copper about twenty quarts of water, with one pound of pearl aſhes, a handful of bran, and half an ounce of madder. This is boiled a quarter of an hour, and the vat is ſerved with it; ſhe is then raked, and cauſes a great quantity of flurry to riſe, and the vat comes to work the next day; this is known by the quantity of flurry with which ſhe is covered by the ſkin or copper-ſcaly cruſt which ſwims on the liquor, which, although it appears of a blue-brown, is nevertheleſs green underneath.

This vat was much longer coming to its colour than the others, becauſe the fire was too ſtrong the ſecond day, otherwiſe ſhe would have been fit to work two days ſooner. This did no other damage but retarded her, and the day ſhe came to work, we dipt in ſerges weighing thirteen or fourteen pounds. As this cauſed her to loſe her ſtrength, and the liquor being diminiſhed by the pieces of ſtuff that had been dyed in her, ſhe was ſerved in the afternoon with freſh liquor, made with one pound of pearl aſhes, half an ounce of madder, and a handful of bran; the whole was boiled together in a copper for a quarter of an hour; the vat being ſerved with it ſhe was raked, covered, and a few embers put round. She may be preſerved after this manner ſeveral days, and when ſhe is wanted to work, ſhe muſt be raked over night, and a little fire placed about her.

When there is occaſion to re-heat, and add indigo to this kind of vat, two thirds of the liquor (which then is no more green, but of a blue-brown and almoſt black) is put into a copper; when it is ready to boil, all the ſcum that is formed at the top is taken off with a ſieve; it is afterwards made to boil, and two handfuls of bran, a quarter of a pound of madder, and two pounds of pearl aſhes are added. The fire is then removed from the copper, and a little cold water caſt into it to ſtop the boil; after which the whole is put into the vat, with one pound of powdered indigo, diluted in a portion of the liquor as before related; after this the vat is raked, covered, and ſome fire put round; the next day ſhe is fit to work.

When the indigo vat has been re-heated ſeveral times, it is neceſſary to empty her entirely, and to ſet a freſh one, or ſhe will not give a lively dye; when ſhe is too old and ſtale, the liquor is not of ſo fine a green as at firſt.

I put ſeveral other vats to work after the ſame method, with different quantities of indigo, from one pound to ſix; always obſerving to augment or diminiſh the other ingredients in proportion, but always one pound of pearl aſhes to each pound of indigo. I have ſince made other experiments, which proved to me that this proportion was not abſolutely neceſſary; and I make no doubt but that ſeveral other means might be found to make the indigo come to as perfect a colour. I ſhall, nevertheleſs, proceed to ſome other obſervations on this vat.

Of all thoſe I ſet to work, after the manner deſcribed, one only failed me, and that by neglecting to put fire round her the ſecond day. She never came to a proper colour; powdered arſnic was put in to no effect; red-hot bricks were alſo plunged in at different times; the liquor turned of a greeniſh hue, but never came to the proper colour; and having attempted ſeveral other means without ſucceſs, or without being able to find out the cauſe of her not ſucceeding, I cauſed the liquor to be emptied and caſt away.

All the other accidents that have happened me in conducting the indigo vat, have only lengthened the operation; ſo that this proceſs may be looked upon as very eaſy when compared to that of the woad vat. I have alſo made ſeveral experiments on both, in which my chief view was to ſhorten the time of the common preparation; but not meeting with the deſired ſucceſs, I ſhall not relate them.

The liquor of the indigo vat is not exactly like that of the woad; its ſurface is of a blue-brown, covered with coppery ſcales, and the under part of a beautiful green. The ſtuff or wool dyed in this is green when taken out, and becomes blue a moment after.—We have already ſeen that the ſame happens to the ſtuff dyed in the woad vat; but it is remarkable, that the liquor of the laſt is not green, and yet produces on the wool the ſame effect as the other. It muſt alſo be obſerved, that if the liquor of the indigo vat be removed out of the veſſel in which it was contained, and if too long expoſed to the air, it loſes its green and all its quality, ſo that, although it gives a blue colour, that colour is not laſting.

I ſhall examine this more particularly in the ſequel, and endeavour to give the chymical theory of this change.

CHAP. V.

THE COLD VAT WITH URINE.

A VAT is alſo prepared with urine, which yields its colour cold, and is worked cold: for this purpoſe four pounds of indigo are powdered, which is to be digeſted on warm aſhes twenty-four hours, in four quarts of vinegar; if it is not then well diſſolved, it muſt be ground again with the liquor, and urine is to be added little by little, with half a pound of madder, which muſt be well diluted by ſtirring the liquor with a ſtick; when this preparation is made, it is poured into a veſſel filled with 250 quarts of urine; it matters not whether it be freſh or ſtale; the whole is well ſtirred and raked together night and morning for eight days, or till the vat appears green at the ſurface when raked, or that ſhe makes flurry as the common vat; ſhe is then fit to work, without more trouble than previouſly raking her two or three hours before. This kind of vat is extremely convenient, for when once ſet to work, ſhe remains good till ſhe be entirely drawn, that is, till the indigo has given all its colour; thus ſhe may be worked at all times, whereas the common vat muſt be prepared the day before.

This vat may at pleaſure be made more or leſs conſiderable by augmenting or diminiſhing the ingredients in proportion to the indigo intended to be made uſe of; ſo that to each pound of indigo add a quart of vinegar, two ounces of madder, and ſixty or ſeventy quarts of urine. This vat comes ſooner to work in ſummer than in winter, and may be brought ſooner to work by warming ſome of the liquor without boiling, and returning it into the vat; this proceſs is ſo ſimple that it is almoſt impoſſible to fail.

When the indigo is quite ſpent, and gives no more dye, the vat may be charged again without ſetting a new one. For this purpoſe, indigo muſt be diſſolved in vinegar, adding madder in proportion to the indigo, pouring the whole into the vat, and raking her night, and morning, and evening as at firſt, ſhe will be as good as before; however ſhe muſt not be charged this way above four or five times, for the ground of the madder and indigo would dull the liquor, and in conſequence render the colour leſs bright. I did not try this method, and therefore do not anſwer for the ſucceſs; but here follows another with urine which gives a very laſting blue, and which I prepared.

Hot Vat with Urine.

A pound of indigo was ſteeped twenty-four hours in four quarts of clear urine, and when the urine became very blue, it was run through a fine ſieve into a pail, and the indigo which could not paſs, and which remained in the ſieve, was put with four quarts of freſh urine; this was ſo continued till all the indigo had paſſed through the ſieve with the urine; this laſted about two hours. At four in the afternoon three hogſheads of urine were put into the copper, and it was made as hot as could be without boiling. The urine caſt up a thick ſcum, which was taken up with a broom and caſt out of the copper. It was thus ſcummed at different times, till there only remained a white and light ſcum; the urine, by this means ſufficiently purified and ready to boil, was poured into the wooden vat, and the indigo prepared as above, put in; the vat was then raked, the better to mix the indigo with the urine: ſoon after, a liquor was put into the vat, made of two quarts of urine, a pound of roach-alum, and a pound of red tartar. To make this liquor, the alum and tartar were firſt put into the mortar, and reduced to a fine powder, upon which the two quarts of urine were poured, and the whole rubbed together, till this mixture, which roſe all of a ſudden, ceaſed to ferment: it was then put into the vat, which was ſtrongly raked; and being covered with its wooden cover, ſhe was left in that ſtate all night; the next morning the liquor was of a very green colour; this was a ſign ſhe was come to work, and that ſhe might have been worked if thought proper, but nothing was dyed in her; for all that was done, was only, properly ſpeaking, the firſt preparation of the vat, and the indigo which had been put in was only intended to feed the urine, ſo that to finiſh the preparation the vat was let to reſt for two days, always covered, that ſhe might cool the flower; then a ſecond pound of indigo was prepared, ground with purified urine as before. About four in the afternoon all the liquor of the vat was put into the copper; it was heated as much as poſſible without boiling; ſome thick ſcum formed on it which was taken off,

and

and the liquor being ready to boil was returned into the vat. At the ſame time the ground indigo was put in, with a liquor made as above of one pound of alum, one pound of tartar, and two quarts of urine, a freſh pound of madder was alſo added; then the vat was raked, well covered, and left ſo the whole night. The next morning ſhe was come to work, the liquor being very hot, and of a very fine green, ſhe was worked with wool in the fleece, of which thirty pounds were put into the vat. It was well extended and worked between the hands, that the liquor might the more eaſily ſoak into it; then it was left at reſt for an hour or two, according as lighter or deeper blues are required.

All this time the vat was well covered, that it might the better retain its heat, for the hotter ſhe is, the better ſhe dyes, and when cold acts no more. When the wool came to the ſhade of the blue required, it was taken out of the vat in parcels, about the bigneſs of a man's head, twiſted and wrung over the liquor as they were taken out, till from green, as they were coming out of the vat, they became blue. This change from green to blue is made in three or four minutes. Theſe thirty pounds being thus dyed, and the green taken off, the vat was raked, and ſuffered to reſt for two hours, being all that time well covered; then thirty pounds more were put in, which was well extended with the hands, the vat was covered, and in four or five hours this wool was dyed at the height or ſhade of the firſt thirty pounds; it was then taken out in heaps, and the green taken off as before. This done, the vat had ſtill ſome little heat, but not ſufficient to dye freſh wool; for when ſhe has not a ſufficient heat, the colour ſhe gives would neither be uniform nor laſting, ſo that it muſt be re-heated, and freſh indigo put in as before. This may be done as often as judged proper, for this vat does not ſpoil by age, provided, that whilſt ſhe is kept without working, a little air is let into her.

Re-heating of the Vat with Urine.

About four in the afternoon, the whole liquor of the vat was put into a copper, and a ſufficient quantity of urine added to this liquor, to make up the deficiency that had been loſt by evaporation during the preceding work. This filling commonly takes eight or nine pails of urine; the liquor was then heated and ſcummed as before, and when ready to boil, returned into the vat with a pound of indigo, and the liquor above deſcribed, conſiſting of alum and tartar, of each one pound, madder one pound, and two quarts of urine. After raking the vat well, and covering her, ſhe was left at reſt the whole night.

The next day ſhe came to work, and ſixty pounds of wool were dyed in her at twice as before. It is after this manner all the re-heatings muſt be done the evening before the dying,and theſe re-heatings may extend to infinity, as the vat, once ſet, ſerves a long time.

I muſt here obſerve, that the greater the quantity of indigo put in at once is, the deeper the blue: thus, inſtead of one pound, four, five, or ſix pounds may be put in together; nor is it neceſſary to augment the doſe of alum, tartar, or madder, of which ingredients the liquor is compoſed; but if the veſſel hold more than three hogſheads, then the doſe of theſe muſt be augmented in proportion. The vat I have mentioned held three, and was too ſmall to dye at one time a ſufficient quantity of wool to make a piece of cloth, viz. fifty or ſixty pounds; for this purpoſe it would be neceſſary that the vat ſhould contain at leaſt ſix hogſheads, and from this a double advantage would ariſe. 1. All the wool will be dyed in three or four hours, whereas dying it at twice, it takes eight or ten hours. 2. At the end of three hours, in which time the wool would be dyed, taken out, and the green taken off, the vat being yet very hot; after raking and letting her reſt a couple of hours, the ſame wool might be returned into her, which would heighten the colour very much; for all wool that has been dyed, aired, and the green taken off, always takes a finer colour than new or white wool, which might remain twenty hours in the vat.

Great care muſt be taken to air and take off the green of the dyed parcels of wool that are taken out of the vat haſtily, that the air may ſtrike them equally, without which the blue colour will not be uniform throughout the wool.

There are manufacturers who ſay that cloths, whoſe wool has received this ground of blue with urine, cannot be perfectly ſcoured at the fulling mill, even at twice; others vouch the contrary, and I am of opinion the laſt ſpeak the truth; yet, if the firſt are right, it might be ſuſpected that the animal oil of the urine becoming reſinous by drying on the wool, or by uniting with the oil with which the wool is moiſtened; for its other preparations more ſtrongly reſiſt the fuller's earth and ſoap, than a ſimple oil by expreſſion. To remedy this, the wool ought to be well waſhed in a running water after it is dyed, twiſted, aired, the green taken off, and cooled. Be it as it may, the woad vat will always be preferred in the great dye-houſes to thoſe kinds of indigo vats made with urine or otherwiſe; and for this reaſon, that with a good woad vat, and an ingenious woadman, much more work is deſpatched than with all the other blue vats.

I have deſcribed the indigo vats in this treatiſe, not with a deſign to introduce them in the large manufactories, but to procure eaſy means to the Dyers in ſmall, and ſmall manufactories, to whom I wiſh this work may be of as much advantage as to the others. I ſhall therefore here deſcribe a cold vat, which may be uſed with advantage by thoſe who dye ſmall ſtuffs, in whoſe compoſition thread and cotton enter. The colour is laſting, but cannot be made uſe of for wool.

CHAP. VI.

OF THE COLD INDIGO VAT WIHOUT URINE.

IT is cuſtomary at Rouen, and in ſome other cities of France, to dye in a cold indigo vat, different from that deſcribed in the foregoing chapter, and more covenient, as ſhe comes to work ſooner, and has no bad ſmell. She is prepared after the following manner:

Diſſolve three pounds of indigo powdered finely, in a glazed earthen pot, with three pints of ſtrong ſoap-boiler's lees, which is a ſtrong lee of ſoda and quick lime. The indigo takes about twenty four hours diſſolving, and when perfectly ſo, remains ſuſpended in the liquor, thickens it, and gives it the conſiſtence of an extract. At the ſame time, three pounds of fitted ſlacked lime muſt be put into another veſſel, with ſix quarts of water, and boiled together for a quarter of an hour; when ſettled, the clear is poured off by inclination. Then three pounds of green copperas are to be diſſolved in this clear lime-water, and the whole let to reſt till the next day. Three hundred quarts of water are then put in a large deal-veſſel (no other wood but deal will do, for it would dull and blacken the dye, eſpecially if it was oak.) The two ſolutions which were made the day before are put in, the vat is well-raked, and ſuffered to reſt. I have ſeen her come to colour in two hours after, but this never fails to happen the next day at fartheſt. She makes a great deal of flurry, and the liquor becomes of a fine green colour, but a little more on the yellow than the green of the common vat.

When this vat begins to ſpend herſelf, ſhe is to be quickened without putting in freſh indigo, by making a ſmall liquor with two pounds of green copperas, diſſolved in a ſufficient quantity of lime-water; but when the indigo has ſpent all its colour, ſhe muſt be re-charged by putting in freſh, diſſolved in ſuch a lee as has been deſcribed.

Water of Old Iron.

Some Dyers put into this vat a little water of old iron. It is a mixture of vinegar and water, in which ſome old iron nails have been put to ruſt. They ſay this makes the colour more laſting, but I have experienced, that it is ſufficiently ſo without this, and as good as all the other blues, of which I have before given the preparation.

I ſet ſeveral ſmall vats; thoſe that required to be heated were put in a bath or ſand-heat, in ſmall glaſs bodies; and thoſe that are worked cold were left without doing any thing to them. Theſe laſt are eaſy, being ſufficient to diminiſh the quantity of liquor, and of all the other ingredients, in proportion to the veſſel that is to be ſet, and it is almoſt impoſſible to fail.

As to that which I firſt deſcribed, which is ſet hot, as it is ſomewhat more difficult, and that ſeveral might be willing to try the experiment, which in itſelf is curious, and neither requires expence nor apparatus to perform in ſmall, I ſhall give the proceſs of one which ſucceeded perfectly, and in which I had deſignedly put a greater quantity of indigo than uſually is done in the common proportion.

I boiled two quarts of water with two ſcruples of madder and four ounces of pearl-aſhes; after boiling a quarter of an hour, I put it into a body, which held about four quarts, and had been previouſly heated with warm water, and in which I had put a quarter of a handful of bran. The whole was well ſtirred with a deal ſpatula, the glaſs body put on a very gentle ſand-heat, which only kept it warm, and pretty near the ſame degree of heat that is required for the common indigo vat.

The fire was kept all night, and the next day under the ſand-heat, without any ſenſible change happening; it was only ſtirred twice a-day. The next day ſome flurry began to riſe, and a copper-coloured ſkin formed on the ſurface, and the liquor was of a green-brown; it was then filled up with a liquor made of a quart of water, two ounces of pearl-aſhes, and a little bran. I mixed the whole together, then let it reſt. It came perfectly well to colour, and the next day I dyed ſeveral middling pieces of ſtuffs and wool. Theſe ſmall veſſels may be re-heated and charged again as eaſily as a large one.

I think I have nothing more to ſay concerning the method of ſetting to work all theſe kinds of blue vats; yet I am perſuaded that there are ſeveral other means practiſed in different places, and that it is even eaſy to contrive new ones; however, I can affirm that all thoſe which I have deſcribed are very ſure, and that they have all been worked ſeveral times with the ſame ſucceſs.

CHAP. VII.

OF THE METHOD OF DYING BLUE.

WHEN the vat is once prepared and come to work, the dying of wool or ſtuffs is eaſy. Wet them well in clear warm water, wringing and dipping them in the vat, and keeping them in more or leſs time, according as the colour is required in ſhade. From time to time the ſtuff is aired, that is, taken out of the vat and wrung, ſo that the liquor may fall back into the vat, and expoſed a little to the air, which takes off the green in one or two minutes; for let what vat ſoever be uſed, the ſtuff is always green at its coming out, and only takes the blue colour in proportion as the air acts upon it. It is alſo very neceſſary to let the green go off before it is returned into the liquor to receive a ſecond ſhade, as being then better able to judge of its colour, and know if it is requiſite to give what is called one or ſeveral returnings.

It is an ancient cuſtom among Dyers to reckon thirteen ſhades of blue from the deepeſt to the lighteſt. Although their denominations be ſomewhat arbitrary, and that it is impoſſible exactly to fix the juſt paſſage from one to the other, I ſhall notwithſtanding give the names. They are as follow, beginning with the lighteſt: milk-blue, pearl-blue, pale blue, flat-blue, middling-blue, ſky blue, queen's-blue, turkiſh-blue, watchet-blue, garter-blue, mazareen-blue, deep-blue, and very deep blue.

Theſe diſtinctions are not equally received by all Dyers, nor in all provinces, but the moſt part are known; and it is the only method that can be taken to give an idea of the ſame colour, whoſe only difference is in being more or leſs deep.

It is eaſy to make deep blues. I have already ſaid, that to effect this, the wool or ſtuffs are to be returned ſeveral times into the vat; but it is not ſo in reſpect to light blues; for when the vat is rightly come to work, the wool can ſeldom be left in ſhort time enough, but that it takes more than the ſhade required. It often happens when a certain quantity of wool is to be dipped, and that it cannot all be put in at the ſame time, that what goes in at firſt is deeper than the other. There are ſome Dyers who, to obviate this inconveniency in making very light blues, which they call milk and water, take ſome of the liquor of the indigo vat, and dilute it in a very great quantity of lukewarm water; but this method is a bad one, for the wool dyed in this mixture has not near ſo laſting a colour as that dyed in the vat; as the altering ingredients which are put into the vat with the indigo, ſerves as much to diſpoſe the pores of the ſubject which is dipped in, as to the opening of the colouring fecula which is to dye it, their concourſe being neceſſary for the adheſion of the colour. The beſt method of making theſe very light blues, is to paſs them either in a woad or indigo vat, out of which the colour has been worked, and begins to cool. The woad vat is ſtill preferable to that of the indigo, as it does not dye ſo ſoon.

The blues made in vats that have been worked are duller than the others; but they may be pretty ſenſibly rouſed by paſſing the wool or ſtuffs in boiling water. This practice is even neceſſary to the perfection of all blue ſhades; by this the colour is not only made brighter, but alſo rendered more ſecure, by taking off all that is not well incorporated with the wool; it alſo prevents its ſpotting the hands or linen, which commonly happens, and the Dyers, to gain time, neglect this precaution. After the wool is taken out of the warm water, it is neceſſary to waſh it again in the river, or at leaſt in a ſufficient quantity of water for the carring off all the ſuperfluous looſe dye.

The beſt method to render the blue dye brighter, is by filling them with a thin liquor of melted ſoap, and afterwards cleanſing them from the ſoap by warm water, and, if convenient, by rinſing them in an old cochineal liquor. This method is to be taken with deep blues; but if the ſame was taken with very light blues, they would loſe their bright blue luſtre, and incline to grey.

I hope to have removed all difficulties on the preparation of blue, and in the method of dying it. Some Dyers, for the ſake of gain, ſpare the woad and indigo, and uſe for blue, orchel or logwood, and brazil; this ought to be expreſsly forbid, though this adulterated blue is often brighter than a laſting and legitimate blue. I ſhall take notice of this in the chapters treating on the leſſer dye.

I ſhall now explain the theory of the inviſible change of the blue dye. This colour, which I ſhall here only conſider in relation to its uſe in the dying of ſtuffs of what kind ſoever, has hitherto been extracted only from the vegetable world, and it does not appear that we can hope to uſe in this art the blues the painters employ: ſuch are the Pruſſian blue, which holds of the animal and mineral kind*; the azure, which is a vitrified mineral ſubſtance; the ultramarine, which is prepared from a hard ſtone; the earths that have a blue colour, &c. Theſe matters cannot, without loſing their colour in whole or in part, be reduced into atoms ſufficiently minute, ſo as to be ſuſpended in the ſaline liquid, which muſt penetrate the fibres of the animal and vegetable ſubſtances of which ſtuffs are manufactured; for under this name linen and cotton cloths muſt be comprehended, as well as thoſe wove of ſilk and wool.

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* 1748, Monſ. Macquer, of the Royal Academy of Sciences, found the means of uſing the Pruſſian blue to dye ſilk and cloth, in a blue whoſe brightneſs ſurpaſſed all the blues hitherto known.

Hitherto we know but of two plants that yield blue after their preparation: the one is the iſatis or glauſtum, which is called paſtel in Languedoc, and woad in Normandy. Their preparation conſiſts in a fermentation continued even to the putrefaction of all the parts of the plant, the root excepted; and conſequently in the unfolding of all their principles into a new combination, and freſh order of theſe ſame principles, from whence follows an union of infinite fine particles, which, applied to any ſubject whatever, reflects the light on them very different from what it would be, if theſe ſame particles were ſtill joined to thoſe which the fermentation has ſeparated.

The other plant is the anil, which is cultivated in the Eaſt and Weſt Indies, out of which they prepare that fecula that is ſent to Europe under the name of indigo. In the preparation of this plant the Indians and Americans, more induſtrious than ourſelves, have found out the art of ſeparating only the colouring parts of the plant from the uſeleſs ones; and the French and Spaniſh colonies have imitated them, and thereby made a conſiderable increaſe of commerce.

That the indigo, ſuch as is imported from America, ſhould depoſit on the wool or ſtuffs the colouring parts required by the Dyer, it is infuſed ſeveral ways, the proceſſes of which we have already given. They may be reduced to three; the cold indigo vat may ſerve for thread and cotton; thoſe that are made uſe of hot, are fit for ſtuffs of any kind whatever.

In the cold vat, the indigo is mixed with pearl-aſhes, copperas or green vitriol, lime, madder, and bran. The hot vats are either prepared with water or urine; if with water, pearl-aſhes, and a little madder muſt be added; if with urine, alum and tartar muſt be joined to the indigo. Both of theſe vats, principally intended for wool, require a moderate degree of heat, but at the ſame time ſtrong enough for the wool to take a laſting dye, I mean ſuch as will withſtand the deſtroying action of the air and ſun, the proof of dyes.

I have prepared, as I ſaid before, theſe three vats in ſmall, in cylindrical glaſs veſſels, expoſed to the light, in order to ſee what paſſed before the infuſion came to a colour, that is, whether it was green beneath the flurry at the ſurface, which is a ſign of internal fermentation. I have ſaid that the green colour of the liquor is a condition abſolutely eſſential, and without which, the colour the ſtuff would take would not be a good dye, and would almoſt entirely diſappear on the leaſt proofs.

I ſhall now give a deſcription of the cold indigo vat in ſmall, for the changes are much better ſeen in her, and for this reaſon, that what happens in the two others is not very eſſentially different. It is proper to take notice, that what I ſhall call *part*, in this Obſervation of Experiments, is a meaſure of the weight of four drachms, of all matter either liquid or ſolid, and that it will be this quantity that muſt be ſuppoſed, each time that I uſe that word in the detail of theſe experiments.

I put three hundred parts of water into a veſſel, containing five hundred and twelve, or eight quarts, in which I diſſolved ſix parts of copperas, which gave the liquor a yellow dye. Six parts of pot-aſhes were alſo diſſolved by themſelves in thirty-ſix parts of water. The ſolution made, I digeſted in it ſix parts, or three ounces, of indigo of St. Domingo well ground; it was left over a very gentle fire three hours. The indigo ſwelled, and taking up a larger ſpace, roſe from the bottom of this alkaline liquor, with which it formed a kind of thick ſyrup, which was blue. This was a proof that the indigo was only divided, but not diſſolved; for had its ſolution been perfect, that thick liquor would have been green inſtead of blue; for all liquor that has been tinged blue by a vegetable of any kind, grows green on the admixion of an alkaline ſalt, either concrete or in a liquid form, whether it be a fixed or volatile.

From hence the reaſon is diſcovered why indigo does not dye a ſtuff of a laſting blue when its liquor is not green; for its ſolution not being complete, the alkali cannot act upon theſe firſt elementary particles; as for example, it acts on the tincture of violets, which is a perfect ſolution of the colouring parts of thoſe flowers, which it turns green in an inſtant, and on the firſt contact.

I poured this thick blue liquor into the ſolution of vitriol, and after well ſhaking the mixture, I added ſix parts of lime that had been ſlacked in the air; it was cold weather when this experiment was made; the thermometer was at two degrees under the freezing point, which was the cauſe that this was near four days coming to a colour, and the fermentation, which muſt naturally enſue in all vitriolic liquor, where an alkaline ſalt has been put in, ſuch as pot-aſhes, and an alkaline earth, was carried on with ſo much ſlowneſs that very little ſcum appeared on the ſurface of the liquor. In a hot ſeaſon, and by making uſe of lime newly calcined, theſe kind of vats are ſometimes fit to dye in four hours.

Each time I ſtirred the mixture with a ſpatula, I obſerved that the iron of the vitriol or copperas was the firſt that precipitated to the bottom of the veſſel, and that the alkaline ſalt had precipitated it, to join itſelf to the acid. Thus in this proceſs of the cold indigo vat, a tartar of vitriol after the manner of Tachenius is formed; whereas by the common method of preparing this neutral ſalt, the acid of vitriol is poured on a true alkaline ſalt, ſuch as ſalt of tartar or pot-aſhes. This again is a circumſtance that leads inſenſibly to the theory of the good dye. I deſire the reader to take notice of this, as it will occur in the ſequel of this obſervation, as well as in other chapters.

The earthy parts of the lime precipitate next after the iron; they are eaſily diſtinguiſhed by the whiteneſs, which are yet difficult to diſtinguiſh when the colouring parts of the indigo are ſufficiently looſened. In ſhort, under this white earth the fecula of the indigo depoſits itſelf, and by degrees rarifies in ſuch a manner, that this ſubſtance, which the firſt day was only the eighth of an inch above the precipitated lime, roſe inſenſibly within half an inch of the ſurface of the liquor, and the third day grew ſo opaque and muddy, that nothing further could be diſtinguiſhed.

This rarefaction of the indigo, ſlow in winter, quick in ſummer, and which may be accelerated in winter by heating the liquor to fifteen or ſixteen degrees, is a proof that a real fermentation happens in the mixture, which opens the little lumps of indigo, and divides them into particles of an extreme fineneſs; then their ſurfaces being multiplied almoſt *ad infinitum*, they are ſo much the more equally diſtributed in the liquor, which depoſits them equally on the ſubject dipped in to take the dye.

If fermentation comes on haſtily, or in a few hours, whether on account of the heat of the air, or by the help of a ſmall fire, a great quantity of flurry appears; it is blue, and its reflection they have alſo named coppery, becauſe the colours of the rainbow appear in it, and the red and yellow here predominate; however this phænomenon is not peculiar to indigo, ſince the ſame reflection is perceived in all mixtures that are in actual fermentation, and particularly in thoſe which contain fat particles blended with ſalts, urine, ſoot, and ſeveral other bodies put into fermentation, ſhow on their ſurface the ſame variegated colours.

The flurry of the indigo vat appears blue, becauſe expoſed to the external air; but if a ſmall portion of the liquor which is under it be taken up with a ſpoon, it appears more or leſs green in proportion as it is filled with colouring particles. In the courſe of this obſervation, I ſhall ſhow the reaſon of this difference, or, at leaſt, a probable explication of this change of blue, which, as I have ſaid before, is abſolutely neceſſary for ſucceeding in the proceſs deſcribed.

When the vat is in this ſtate, it has already been ſaid that cotton, thread, cloths wove from them, &c. may be dyed in her, and the colours which they take are of the good dye; that is, this cotton and thread will maintain them, even after remaining a ſuitable time in a ſolution of white ſoap, actually boiling. This is the proof given them preferable to any other, becauſe the linen and cotton cloths muſt be waſhed with ſoap when dirty.

Though the indigo liquor which is in this ſtate can make a laſting dye without the addition of any other ingredient; the Dyers who uſe this cold vat add, as in the other hot vats, a decoction of madder and bran in common water run through a ſieve;

this is what they call *bever*. They put madder to inſure, as they ſay, the colour of the indigo, becauſe this root affords a colour ſo adheſive that it ſtands all proofs; they put the bran to ſoften the water, which they imagine generally to contain ſome portion of an acid ſalt, which, according to their opinion, muſt be deadened.

This was the opinion of the French Dyers againſt indigo in the days of Monſieur Colbert; and as this miniſter could not ſpare time to ſee the experiments performed in his preſence, on the foundation of this report, he forbad indigo to be uſed alone. But ſince the Government has been convinced, by new experiments made by the late Mr. Duſay, that the ſtability of the blue dye of this ingredient was ſuch as could be deſired; the new regulation of 1737 licenſes the Dyers to uſe it alone, or mixed with woad; ſo that if they continue to uſe the madder, it is rather becauſe this root giving a pretty deep red, and this red mixing with the blue of the indigo, gives it a tint which approaches the violet, and alſo a fine hue.

As to the bran, its uſe is not to deaden the pretended acid ſalts, but to diſperſe throughout a quantity of ſizey matter; for the ſmall portion of flour which remains in it, dividing itſelf into the liquor, muſt diminiſh in ſome meaſure its fluidity, and conſequently prevent the colouring particles which are ſuſpended in it, being precipitated too quick, in a liquor which had not acquired a certain degree of thickneſs.

Notwithſtanding this diſtributed throughout the liquor, as well from the bran as the madder, which alſo affords ſomething glutinous, the colouring particles will ſubſide if the liquor remains ſome days without being ſtirred; then the top of the liquor gives but a feeble tint to the body dipped in, and if a ſtrong one is wanted, the mixture muſt be raked, and left to reſt an hour or two, that the iron in the copperas, and the groſs parts of the lime may fall to the bottom, which otherwiſe would mix with the true colouring particles, and prejudice their dye, by depoſiting on the body to be dyed a ſubſtance that would have but little adheſion, which in drying would become friable, and of which each minute part would occupy a ſpace, where the true colouring particle could neither introduce nor depoſit itſelf by an immediate contact on the ſubject.

Not to deviate from the method followed by the Dyers, I boiled one part of grape-madder and one of bran, in 174 parts of water: this proportion of water is not neceſſary, more or leſs may be put, but I wanted to fill my veſſel, which contained 512 parts. I paſſed this bever through a cloth and ſqueezed it, putting this liquor, ſtill hot, and which was of a blood-red, into the indigo liquor, obſerving the neceſſary precautions to prevent the breaking of the glaſs veſſel. The whole was well ſtirred, and two hours after the liquor was green, and conſequently fit for dying. It dyed cotton of a laſting blue, ſomewhat brighter than it was before the addition of the red of madder.

I ſhall now endeavour to find out the particular cauſe of the ſolidity of this colour; perhaps it may be the general cauſe of the tenacity of all the reſt; for it appears already, from the experiments above related, that this tenacity depends on the choice of ſalts, which are added to the decoctions of the colouring ingredients, when the ſame ingredients contain none in themſelves. If from the conſequences which ſhall reſult from the choice of theſe ſalts, of their nature, and of their properties, it be admitted (and it cannot be fairly denied) that they afford more or leſs tenuity in the homogeneous colouring parts of the dying ingredients, the whole theory of this art will be diſcovered, without having recourſe to uncertain or conteſted cauſes.

One may eaſily conceive that the ſalts added to the indigo vats not only open the natural pores of the ſubject to be dyed, but alſo unfold the colouring atoms of the indigo.

In the other preparations of dyes (to be mentioned hereafter) the woollen ſtuffs are boiled in a ſolution of ſalts, which the Dyers call preparation. In this preparation tartar and alum are generally uſed. In ſome hours the ſtuff is taken out, ſlightly ſqueezed, and kept damp for ſome days in a cool place, that the ſaline liquor which remains in it may ſtill act, and prepare it for the reception of the dye of theſe ingredients, in the decoction of which it is plunged to boil again. Without this preparation, experience ſhows that the colours will not be laſting, at leaſt for the greateſt part; for it muſt be owned that there are ſome ingredients which yield laſting colours, though the ſtuff has not previouſly undergone this preparation, becauſe the ingredient contains in itſelf theſe ſalts.

It is therefore neceſſary, that the natural pores of the fibres of the wool ſhould be enlarged and cleanſed by the help of thoſe ſalts, which are always ſomewhat corroding, and perhaps they open new pores for the reception of the colouring atoms contained in the ingredients. The boiling of this liquor drives in the atoms by repeated ſtrokes. The pores already enlarged by theſe ſalts, are further dilated by the heat of the boiling water; they are afterwards contracted by the external cold when the dyed matter is taken out of the copper, when it is expoſed to the external air, or when it is plunged into cold water. Thus the colouring atom is taken in, and detained in the pores or fiſſures of the dyed body, by the ſpringineſs of its fibres, which have contracted and reſtored themſelves to their firſt ſtate, and have re-aſſumed their primary ſtiffneſs upon being expoſed to the cold.

If, beſides this ſpring of the ſides of the pore, it be ſuppoſed that theſe ſides have been plaiſtered inwardly with a layer of the ſaline liquor, it will appear plainly that this is another means employed by art to detain the colouring atom; for this atom, having entered into the pore, while the ſaline cement of the ſides was yet in a ſtate of ſolution, and conſequently fluid; and this cement being afterwards congealed by the external cold, the atom is thereby detained; by the ſpring which has been mentioned, and by this ſaline cement, which by cryſtalization is become hard, forms a kind of maſtic which is not eaſily removed.

If the coloured atom, (which is as ſmall as the little eminence that appears at the entrance of the pore, and without which the ſubject would not appear dyed) be ſufficiently protuberant to be expoſed to more powerful ſhocks than the reſiſtance of the ſides of the cement that retains it, then the dye reſulting from all theſe atoms ſufficiently retained, will be extremely laſting, and in the rank of the good dye, provided the ſaline coat can neither be carried off by cold water, ſuch as rain, nor calcined or reduced to powder by the rays of the ſun; for every laſting colour, or colour belonging to the good dye, muſt withſtand theſe two proofs. No other can reaſonably be expected in ſtuffs deſigned for apparel or furniture.

I know but of two ſalts in chymiſtry, which, being once cryſtalized, can be moiſtened with cold water without diſſolving; and there are few beſides theſe that can remain ſeveral days expoſed to the ſun, without being reduced to a flour or white powder. Theſe are tartar, either as taken from the wine veſſels, or purified, and tartar of vitriol. The tartar of vitriol may be made by mixing a ſalt already alkalized, (or that may become ſuch when the acid is drove out with a ſalt whoſe acid is vitriolic, as copperas and alum); this is eaſily effected if it be weaker than the acid of vitriol, and ſuch is the acid of all eſſential ſalts extracted from vegetables.

In the proceſs of the blue vat, which I tried in ſmall, to diſcover the cauſe of its effects, copperas and pot-aſh, (which is a prepared alkali) are mixed together; as ſoon as theſe ſolutions are united, the alkali precipitates the iron of the copperas in form of powder almoſt black; the vitriolic acid of the copperas, diveſted of its metallic baſis by its union with the alkali, forms a neutral ſalt, called *tartar of vitriol*, as when made with the ſalt of tartar and the vitriolic acid already ſeparated from its baſis; for all alkalis, from whatever vegetables they are extracted, are perfectly alike, provided they have been equally calcined.

More difficulties will occur with regard to the water for the preparation of other colours, ſuch as reds and yellows. It may be denied that a tartar of vitriol can reſult from the mixture of alum and crude tartar boiled together; yet the theory is the ſame, and I do not know that it can be otherwiſe conceived. The alum is a ſalt, conſiſting of the vitriolic acid united with an earth; by adding an alkali, the earth is immediately precipitated, and the tartar ſoon forms; but inſtead of this alkaline ſalt, alum is boiled with the crude tartar, which is the eſſential ſalt of wine, that is, a ſalt compoſed of the vinous acid, (which is more volatile than the vitriolic) and of oil, both concentrated in a ſmall portion of earth.

This ſalt, as is known to chymiſts, becomes alkali by diveſting it of its acid. Thus when the alum and crude tartar are boiled together, beſides the impreſſion which the fibres of the ſtuff to be dyed receive from the firſt of theſe ſalts, which is ſomewhat corroſive, the tartar is alſo purified, and by the addition of the earth, which is ſeparated from the alum, (and which has near the ſame effect upon the tartar, as the earth of *Merviels*, which is uſed at Montpellier in manufacturing cream of tartar) it becomes clear and tranſparent. It may very probably happen, that the vitriolic acid of the alum, driving out a part of the vegetable acid of the tartar, a tartar of vitriol may be formed as hard and tranſparent as the cryſtal of tartar. Admitting one or other of theſe ſuppoſitions, conſequently there is in the open pores of the wool a ſaline cement which cryſtalizes as ſoon as the ſtuff which comes out of the dye is expoſed to the cold air, which cannot be calcined by heat, nor is ſoluble in cold water. I could not avoid making this digreſſion.

This theory is common to the indigo vat, where urine is uſed inſtead of water; alum and crude tartar in the place of vitriol and pot-aſhes. This urine vat gives a laſting dye only when uſed hot, and then the wool muſt remain in an hour or two to take the dye equally. As ſoon as the vat is cold, ſhe ſtrikes no more dye; the reaſon of this would be difficult to diſcover in an opaque metal vat, but in a glaſs veſſel it is eaſily ſeen.

I let this little glaſs proof vat cool, and all the green colour, which was ſuſpended in it while hot, precipitated little by little to the bottom; for then the tartar cryſtalizing itſelf, and reuniting in heavier maſſes than its moculas were during the heat of the liquor, and its ſolution, it ſunk to the bottom of the veſſel, and carried with it the colouring particles.

When I reſtored this liquor to its former degree of heat, after ſhaking it, and letting it ſettle a while, I dipped a piece of cloth, which I took out one hour after, with as laſting a dye as the firſt; ſo that when this vat is uſed and fit to work, the tartar is to be kept in a ſtate of ſolution, which cannot be done but by a pretty ſtrong heat. The alkali of the urine greens it, the alum prepares the fibres of the wool, and the cryſtal of tartar ſecures the dye by cementing the colouring atoms depoſited in the pores.

There ſtill remains a difficulty with reſpect to the indigo vat, in which, neither vitriol, alum, or tartar are uſed, but only pearl-aſhes in equal quantity with the indigo, and which is pretty briſkly heated to dye the wool and ſtuffs. But before I enter into the cauſe of the ſolidity of its dye, which is equal to that of the other blue vats where the other ſalts already mentioned enter, I muſt examine into the nature of pearl-aſhes, which are the lees of wine dried and calcined: it is therefore an alkaline ſalt, of the nature of ſalt of tartar, but leſs pure, as proceeding from the heavieſt parts of the dregs of wine, and conſequently the moſt earthy; beſides, the alkali of the pearl-aſhes is never as homogeneous as the alkaline ſalt of tartar well calcined, and there are ſcarcely any pearl-aſhes not purified, from which a conſiderable quantity of tartar of vitriol may not be obtained: it is even probable by an experiment which I have related, that it might at length be entirely converted into this neutral ſalt; the ſame may be ſaid of pot-aſhes, and of all other alkaline ſalts, whoſe baſis are not that of the marine ſalt.

The want of this homogeneous quality, is the cauſe that pearl-aſhes never fall entirely into deliquium in the air; therefore ſince experience ſhows that there is a tartar of vitriol already formed in the pearl-aſhes, it is evident that this indigo vat, which does not give a good dye until the liquor has been ſo briſkly heated as not to ſuffer the hand without ſcalding, will diſſolve the ſmall portion of tartar of vitriol that is contained in it, and conſequently this ſalt will introduce itſelf into the pores of the wool to cleanſe and cement them, and will coagulate therein on the wool being taken out of the liquor, and expoſed to the air to cool.

I muſt now give the reaſon why the indigo vat is green under the firſt ſurface of the liquor; why this liquor muſt be green that the blue dye may be laſting, and why the ſtuff that is taken green out of the liquor becomes blue as ſoon as it is aired. All theſe conditions being of neceſſity common to all indigo vats either cold or hot, the ſame explication will ſerve for them all.

1. The flurry which riſes on the ſurface of the indigo liquor when it is fit to dye is blue, and the under part of this ſcum is green; theſe two circumſtances prove the perfect ſolution of the indigo, and that the alkaline ſalt is united to its colouring atoms ſince it greens them, for without they would remain blue.

2. Theſe circumſtances prove that there is alſo in the indigo a volatile urinous alkali, which the fixt alkali of the pot-aſh, or the alkaline earth of the lime diſplays, and which evaporates very ſhortly after the expoſition of this ſcum to the air. The exiſtence of this urinous volatile appears plainly by the ſmell of the vat during the fermentation; when ſtirred, or when heated, the ſmell is ſharp, and reſembles that of ſtinking meat roaſted.

3. In the preparation of the anil, in order to ſeparate the fecula, a fermentation is continued to putrefaction. All rotten plants are urinous. This volatile urinous quality is produced by the intimate union of ſalts with the vegetable oil, or is owing to a prodigious quantity of inſects falling on all ſides of fermenting planks, and attracted by the ſmell exhaling from them, where they live, multiply, and die in them, and conſequently depoſit a number of dead bodies; therefore to this vegetable ſubſtance an animal one is united, whoſe ſalt is always an urinous volatile. This ſame urinous quality exiſts alſo in the woad, which is prepared after the ſame manner, viz. by fermentation and putrefaction, and which will be further explained in the abridged narrative of its preparation.

4. And laſtly, if indigo or woad be diſtilled in a retort, either alone, or (which is much better) with ſome fixed ſaline or earthy alkali added to it, a liquor will be obtained, which, by all chymical eſſays, produces the ſame effects as volatile ſpirits of urine.

Why does not this volatile urinous quality in the indigo cauſe it to appear green, ſince it muſt be equally diſtributed through all its parts? And why does indigo, being diſſolved in plain boiling water, tinge it blue and not green? It is becauſe this volatile urinous ſalt is not concreted; that it requires another body more active than boiling water to drive it out of the particles ſurrounding it; and the ſolution of indigo is never perfected by water alone; whatever degree of heat is given, it is only diluted, and not diſſolved in it. Indeed this decoction of indigo blues the ſtuffs that are dipped, but the blue is not equally laid on, and boiling water almoſt inſtantly diſcharges it. I ſhall endeavour to anſwer this by an example drawn from another ſubject.

Salt ammoniac, from which chymiſts extract the moſt penetrating volatile ſpirit, has not that quick urinous ſmell by diſſolving and boiling it in water; either lime, or fixed alkaline ſalt, muſt be added to diſengage the urinous volatile parts. In like manner, the indigo requires fixed ſaline, or earthy alkalis, to be exactly diſcompoſed, that its volatile urinous ſalt may be diſcovered, and that its colouring atoms may be reduced probably to their elementary minuteneſs.

I now come to the ſecond quality required. The liquor of the indigo vat muſt be green, that the dye may be laſting; for the indigo would not be exactly diſſolved, if the alkali did not act upon it. Its ſolution not being as perfect as it ought to be, its dye would be neither equal nor laſting; but as ſoon as the alkaline ſalts act upon it, they muſt green it; for an alkali, mixed with the blue juice or tincture of any plant or flower, immediately turns it green, when equally diſtributed on all its colouring parts. But if by evaporation theſe ſame parts, coloured, or colouring, have re-united themſelves into hard and compact maſſes, the alkali will not change their colour till it has penetrated, divided, and reduced them to their primary fineneſs. This is the caſe with indigo, whoſe fecula is the dry inſpiſſated juice of the anil.

With reſpect to the laſt circumſtance, which is that the ſtuff muſt be green on coming out of the liquor, and become blue as ſoon as it is aired, without which, the blue would not be of a good dye, the following reaſons may be given: it is taken out green becauſe the liquor is green; if it was not, the alkaline ſalt put into the vat would not be equally diſtributed, or the indigo would not be exactly diſſolved. If the alkali was not equally diſtributed, the liquor contained in the vat would not be equally ſaline: the bottom of this liquor would contain all the ſalt; the upper would be inſipid. In this caſe, the ſtuff dipped in would neither be prepared to receive the dye, nor to retain it; but when it is taken out green at the end of a quarter of an hour's dipping, it is a proof that the liquor was equally ſaline, and equally loaded with colouring atoms; it is alſo a ſign, that the alkaline ſalts have inſinuated themſelves into the pores of the fibres of the ſtuff and enlarged them, as has been obſerved, and perhaps have formed new ones. Now there can be no doubt that an alkaline ſalt may have this effect on a woollen ſtuff, when it is evident that a very ſharp alkaline ley burns and diſſolves almoſt in an inſtant a flock of wool or a feather.

A proceſs in dying called, by the French, *fonte de bourre*, that is, the melting or diſſolving of flock or hair, is ſtill a further example. The hair, which is uſed and boiled in a ſolution of pearl-aſhes in urine, is ſo perfectly diſſolved as not to leave the leaſt fibre remaining. Therefore if a lixivium, extremely ſharp, entirely deſtroys the wool, a ley which ſhall have but a quantity of alkaline ſalt ſufficient to act on the wool without deſtroying it, will prepare the pores to receive and preſerve the colouring atoms of the indigo.

The ſtuff is aired after being taken green out of the vat, and after wringing it becomes blue. What is done by airing? it is cooled; if it is the urinous volatile detached from the indigo which gave it this green colour, it evaporates, and the blue appears again; if it is the fixed alkaline that cauſes this green, not only the greateſt part is carried off by the ſtrong expreſſion of the ſtuff, but what remains can have no more action on the colouring part, becauſe the ſmall atom of tartar of vitriol, which contains a coloured atom ſtill leſs than itſelf, is cryſtalized the inſtant of its expoſition to the cold air, and contracting this ſame colouring atom by the help of the ſpring at the ſides of the pore, it entirely preſſes out the remainder of the alkali, which does not cryſtalize as a neutral ſalt.

The blue is rouſed, that is, it becomes brighter and finer by ſoaking the dyed ſtuff in warm water, for then the colouring particles, which had only a ſuperficial adherence to the fibres of the wool, are carried off. Soap is uſed as a proof of the laſting of the blue dye, and it muſt ſtand it, for the ſoap, which is only uſed in a ſmall quantity in proportion to the water, and whoſe action on the dyed pattern is fixed to five minutes, is an alkali, mitigated by the oil, which cannot act upon a neutral ſalt. If it diſcharges the pattern of any part of its colour, it is becauſe its parts were but ſuperficially adhering; beſides, the little ſaline cryſtal which is ſet in the pore, whoſe uſe is to cement the colouring atom, cannot be diſſolved in ſo ſhort a time, ſo as to come out of the pore with the atom it retains.

This treatiſe lays down the eſſay of a method of dying different from any hitherto offered. I appeal to philoſophers, who would think little of a ſimple narrative of proceſſes, if I did not at the ſame time give their theory. I ſhall follow this method in the other experiments on reds, the yellows, or other ſimple colours, as it is abſolutely neceſſary to have a knowledge of them before entering on the compound, as theſe are generally but colours laid on one after the other, and ſeldom mixed together in the ſame liquor or decoction.

Thus having once the knowledge of what procures the tenacity of a ſimple colour, it will be more eaſily known, if the ſecond colour can take place in the ſpaces the firſt have left empty without diſplacing the firſt.

This is the idea which I have formed to myſelf of the arrangement of different colours laid on the ſame ſtuff, for it appears to me a matter of great difficulty to conceive that the colouring atoms can place themſelves the one on the other, and thus form kinds of pyramids, each ſtill preſerving their colour, ſo that from a mixture of the whole a compound colour ſhall reſult, and which, notwithſtanding, ſhall appear uniform, and as it were homogeneous. To adopt this ſyſtem, we muſt ſuppoſe a tranſparency in theſe atoms, which it would be difficult to demonſtrate; and further, that a yellow atom muſt place itſelf immediate on a blue one, already ſet in the pore of the fibre of a ſtuff, and that it muſt remain there ſtrongly bound, ſo that they muſt touch each other with extreme ſmooth ſurfaces, and ſo with every new colour laid on.

It is not eaſy to conceive all this, and it appears more probable, that the firſt colour has only taken up the pores that it found open by the firſt preparation of the fibres of the ſtuff; that on the ſide of theſe pores there remains more ſtill to be filled, or at leaſt ſpaces not occupied, where new pores may be opened to lodge the new atoms of a ſecond colour, by the means of a ſecond preparation of water, compoſed of corroding ſalts, which being the ſame as thoſe of the firſt preparing liquor, will not deſtroy the firſt ſaline cryſtals introduced into the firſt pores.

What has been already ſaid with regard to the indigo vat, may alſo ſerve to explain the action of the woad vat on wool and ſtuffs; it is only ſuppoſſing in the woad, that ſalts do naturally exiſt, pretty near of affinity to thoſe that are added to the indigo vat. It appears by the deſcription given of theſe vats, that the woad vat is by much the moſt difficult to conduct. I am convinced that theſe difficulties might be removed, if an attempt was made to prepare the iſatis as the anil is in the Weſt Indies. I ſhall therefore compare their different preparations. I have taken the following narrative from the memoirs of Mr. Aſtruc's *Hiſtoire Naturelle du Languedoc. Paris, Cavalier* 1737, in 4to, p. 330 and 331.

"According to the opinion of Dyers, woad "only gives feeble and languiſhing colours; "whereas thoſe of the indigo are lively and bright. "This opinion I grant is conformable to reaſon: "the indigo is a fine ſubtle powder; conſequently "capable to penetrate the ſtuffs eaſily, and give "them a ſhining colour. The woad, on the con- "trary, is only a groſs plant, loaded with many "earthy parts, which ſlacken the action and mo- "tion of the finer parts, and prevent them from "acting effectually.

"I know but one way to remove this inconve- "niency, that is, to prepare the woad after the ſame "manner the indigo is prepared; by this means, "the colours obtained from the woad would ac- "quire the lively and bright qualities of thoſe pro- "cured from the indigo, without diminiſhing in "the leaſt the excellency of the colours produced "by the woad.

"I have already made in ſmall * experiments on "what I propoſe, and thoſe experiments have ſuc- "ceeded, not only in the preparation of the powder "of wood, but alſo in the uſe of this powder for "dying."

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* As this ingenious man has ſucceeded in ſmall experiments, it is probable he would alſo in the large ones; and then this plant eaſily cultivated in England, would well recompence the pains of the huſbandman.

It is incumbent on thoſe who have the public good at heart, to cauſe trials at large to be made, and if they have the ſucceſs that can reaſonably be expected, it will be proper to encourage thoſe who cultivate woad, to follow this new method of preparing it, and offer premiums to enable them to ſuſtain the expences this new practice will engage them in, until the advantage they will reap from it may be ſufficient to determine them to follow it.

I ſhall now propoſe the means to ſucceed in Mr. Aſtruc's experiments, and theſe means naturally reſult from conſidering the method uſed in Languedoc for the preparation of woad, and the ingenious method by which they ſeparate the fecula of the anil in America. I have already given the preparation of this laſt; thoſe who deſire a fuller deſcription may conſult *l'Hiſtoire des Antilles du P. du Tertre & du P. Labat.* The following preparation of the paſtel, or garden woad, is thus deſcribed by Mr. Aſtruc.

The manufacturing of Paſtel, or Garden Woad in France.

Peaſants of Abbigevois diſtinguiſh two kinds of woad ſeed; the one violet colour, the other yellow: they prefer the former, becauſe the woad that ſhoots from it bears leaves that are ſmooth and poliſhed, whereas thoſe that ſpring from the yellow are hairy; this fills them with earth and duſt, which makes the woad prepared from them of a worſe quality. This woad is called *paſtelbourg*, or *bourdaigne*.

The woad at firſt ſhoots five or ſix leaves out of the ground, which ſtand upright whilſt green; they are a foot long, and ſix inches broad; they begin to ripen in June; they are known to be ripe by their falling down and growing yellow; they are then gathered, and the ground cleared from weeds, which is carefully repeated each crop.

If there has been rain, a ſecond crop is obtained in July; rain or dry weather advances or retards it eight days. The third crop is at the latter end of Auguſt; a fourth the latter end of September; and the fifth and laſt about the tenth of November. This laſt crop is the moſt conſiderable, the interval being longer. The plant at this crop is cut at the root from whence the leaves ſpring. This woad is not good, and the laſt crop is forbid by the regulations. The woad is not to be gathered in foggy or rainy weather, but in ſerene weather, when the ſun has been out ſome time.

At each crop the leaves are brought to the mill to be ground, and reduced to a fine paſte; this is to be done ſpeedily, for the leaves when left in a heap ferment, and ſoon rot with an intolerable ſtench. Theſe mills are like the oil or bark-mills, that is, a mill-ſtone turns round a perpendicular pivot in a circular grove or trough, pretty deep, in which the woad is ground.

The leaves thus maſhed and reduced to a paſte, are kept up in the galleries of the mill, or in the open air. After preſſing the paſte well with the hands and feet, it is beat down and made ſmooth with a ſhovel. This is called the woad piled.

An outward cruſt forms, which becomes blackiſh; when it cracks, great care muſt be taken to cloſe it again. Little worms will generate in theſe crevices and ſpoil it. The pile is opened in a fortnight, well worked between the hands, and the cruſt well mixed with the inſide; ſometimes this cruſt requires to be beat with a mallet to knead it with the reſt.

This paſte is then made into ſmall loaves or round balls, which, according to the regulations, muſt weigh a pound and a quarter. Theſe balls are well preſſed in the making, and are then given to another, who kneads them again in a wooden diſh, lengthens them at both ends, making them oval and ſmooth. Laſtly, they are given to a third, who finiſhes them in a leſſer bowl-diſh, by preſſing and perfectly uniting them.

The paſtel or woad thus prepared is called *Paſtel en Cocaigne*; whence ariſes the proverb, *Pais de Cocaigne*; which ſignifies a rich country, becauſe this country * where the woad grows, enriched itſelf formerly by the commerce of this drug.

Theſe balls † are ſpread on hurdles, and expoſed to the ſun in fine weather; in bad weather they are put at the top of the mill. The woad that has been expoſed ſome hours to the ſun, becomes black on the outſide, whereas that which has been kept within doors is generally yellowiſh, particularly if the weather has been rainy. The merchants prefer the former; this makes little difference as to its uſe; it is in general always yellowiſh, as the peaſants moſtly work it in rainy weather, when they cannot attend their rural employments.

In ſummer, theſe balls are commonly dry in fifteen or twenty days, whereas in autumn thoſe of the laſt crop are long in drying.

The good balls when broke are of a violet colour within, and have an agreeable ſmell; whereas thoſe that are of an earthy colour and a bad ſmell, are not good: this proceeds from the gathering of the woad during the rain, when the leaves were filled with earth. Their goodneſs is alſo known by their weight, being light when they have taken too much air, or rotten by not having been ſufficiently preſt.

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* *L'Abigeois* & *Lauragais*.

† There is a place in India, the name I do not recollect, where the anil is prepared after the manner of the woad, and the indigo comes from it in lumps, containing all the uſeleſs parts of the plant.—It is very difficult to prepare a blue vat with it.

Powder of Woad.

Of theſe balls well prepared, the powder of woad is to be made; for this purpoſe a hundred thouſand at leaſt are required. A diſtant barn or a warehouſe muſt be procured, larger or ſmaller according to the quantity intended to be made. It muſt be paved with bricks and lined with the ſame, to the height of four or five feet; the walls would be better to be of ſtone to that height, yet often the walls are only coated with earth; this coat breaking off and mixing with the woad is a great prejudice to it. In this place the balls are reduced to a groſs powder with large wooden mallets. This powder is heaped up to the height of four feet, reſerving a ſpace to go round, and is moiſtened with water; that which is ſlimy * is beſt, provided it be clear; the woad thus moiſtened, ferments, heats, and emits a very thick ſtinking vapour.

It is ſtirred every day for twelve days, flinging it by ſhovels full from one ſide to the other, and moiſtening it every day during that time; after which no more water is flung on, but only ſtirred every ſecond day; then every third, fourth, and fifth; it is then heaped up in the middle of the place, and looked at from time to time to air it in

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* I can ſee no reaſon why ſlimy water, and yet to be clear, is preferred. It appears to me that clear river water would be more ſecure; with this they would avoid the inconveniences that muſt attend a ſtanding water, always filled with filth; or of a muddy water, which contains uſeleſs earth, and which muſt make the dye uneven.

caſe it ſhould heat. This is the paſtel or garden woad powder fit for ſale to the Dyers.

Mr. Aſtruc, to prove that the ſale of woad formerly enriched the higher Languedoc, quotes the following paſſage from a book entitled *Le Marchand.*

"Formerly they tranſported from Toulouze to Bourdeaux, by the river Garonne, each year a hundred thouſand bales of woad, which on the ſpot are worth at leaſt fifteen livres a bale, which amounts to 1,500,000 livres; from whence proceeded the abundance of money and riches of that country." Caſtel in his *Memoirs de l'Hiſtoire du Languedoc*, in 1633, p. 49.

The comparing of theſe two methods of preparing the woad and indigo may be ſufficient to a perſon of underſtanding, who might be appointed to try, by experiments, the poſſibility of extracting a fecula from the iſatis of Languedoc like that of the anil. It is neither the Dyer or Manufacturer that ought be applied to for that purpoſe; both would condemn the project as a novelty, and it would require many experiments, which in general they are not accuſtomed to.

I could wiſh this experiment was tried in great, ſo that at leaſt fifty pounds of this fecula might be got, that ſeveral vats might be ſet in caſe the firſt ſhould fail. Whoever does try it, ſhould be very careful to deſcribe all the circumſtances of the proceſs. Perhaps it might not ſucceed at the firſt crop of the leaves of the woad, becauſe the heat in June is not ſufficient, but probably he might meet with ſucceſs in Auguſt.

If this ſucceeds, there are without doubt ſeveral other plants of the ſame quality as the iſatis, and which yields a like fecula.

It is alſo probable that the dark green of ſeveral plants is compoſed of yellow and blue parts; if by fermentation the yellow could be deſtroyed, the blue would remain. This is not a chimerical idea, and it is eaſy to prove that ſome uſe might be derived from ſuch an experiment.

CHAP. VIII.

OF RED.

RED, as has been ſaid, is one of the primary or mother colours of the Dyers. In the great dye there are four principal reds, which are the baſis of the reſt. Theſe are,

1. Scarlet of grain. 2. The ſcarlet, now in uſe, or flame-coloured ſcarlet, formerly called Dutch ſcarlet. 3. The crimſon red. And, 4. The madder red.

There are alſo the baſtard ſcarlet and the baſtard crimſon; but as theſe are only mixtures of the principal reds, they ought not to be conſidered as particular colours.

The red, or *nacaret* of *bourre* *. was formerly permitted in the great dye.

All theſe different reds have their particular ſhades from the deepeſt to the lighteſt, but they form ſeparate claſſes, as the ſhades of the one never fall into thoſe of the other.

The reds are worked in a different manner from the blues, the wool or ſtuffs not being immediately dipped in the dye, but previouſly receiving a preparation which gives them no colour, but prepares them to receive that of the colouring ingredient.

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* This colour is given with weld and goat's hair boiled in potaſhes, and is a bright orange red.

This is called the water of preparation; it is commonly made with acids, ſuch as ſour waters, alum and tartar, aqua fortis, aqua regalis, &c. Theſe preparing ingredients are uſed in different quantities, according to the colour and ſhade required. Galls are alſo often uſed, and ſometimes alkaline ſalts. This I ſhall explain in the courſe of this treatiſe, when I come to the method of working each of theſe colours.

CHAP. IX.

OF SCARLET OF GRAIN.

THIS colour is called ſcarlet of grain, becauſe it is made with the kermes, which was long thought to be grain of the tree on which it is found. It was formerly called French ſcarlet, imagining it to be firſt found out in France, and is now known by the name of Venetian ſcarlet, being much in uſe there, and more made than in any other place. The faſhion paſſed from thence into France and other countries. It has indeed leſs luſtre, and is browner than the ſcarlet now in faſhion; but it has the advantage of keeping its brightneſs longer, and does not ſpot by mud or acid liquors.

The kermes is a gall inſect, which is bred, lives, and multiplies upon the *ilex acculeata cocci glandiſera*, *C. B. P.* Some comes from Narbonne, but greater quantities from Alicant and Valentia, and the peaſants of Languedoc yearly bring it to Montpelier and Narbonne. The merchants, who buy them to ſend abroad, ſpread them on cloths, and ſprinkle them with vinegar, in order to kill the little inſects that are within, which yield a red powder, which is ſeparated from the ſhell after drying, and is then paſſed through a ſieve; this is done particularly in Spain.

They then make it up in bales, and in the middle of each a quantity of this powder is incloſed in a leather bag, in proportion to the whole bale. Thus each Dyer has his due proportion of this powder. Theſe bales are generally ſent to Marſeilles, from whence they are exported to the Levant, Algiers, and Tunis, where it is greatly made uſe of in dying.

The red draperies of the figures in the ancient tapeſtry of Bruſſels, and other manufactories of Flanders, are dyed with this ingredient; and ſome that have been wrought upwards of two hundred years, have ſcarcely loſt any thing of the brightneſs of the colour. I ſhall now proceed to give the method of making this ſcarlet of grain, which is now ſeldom uſed but for wools deſigned for tapeſtry.

Preparation of the Wool for Scarlet of Grain.

Twenty pounds of wool and half a buſhel of bran are put into a copper, with a ſufficient quantity of water, and ſuffered to boil half an hour, ſtirring it every now and then; it is then taken out to drain.

It is neceſſary to obſerve, that whenever ſpun wool is to be dyed, a ſtick is paſſed through each hank (which commonly weighs one pound) and they remain on the ſtick during the courſe of the work to prevent their entangling. This ſtick alſo enables the Dyer to return the hanks with more eaſe, by plunging each part ſucceſſively in the liquor, by which they take an equal dye; by raiſing the hank with a ſtick, and drawing it half way out of the copper, ſeizing the other end of the hank with the other hand, it is plunged towards the bottom. If the wool be too hot, this may be done with two ſticks, and the oftener this is repeated, the more even will be the dye; the ends of the ſticks are then placed on two poles to drain. Theſe poles are fixed in the wall above the copper.

Liquor for the Kermes.

While this prepared wool is draining, the copper is emptied, and freſh water put in, to which is added about a fifth of ſour water, four pounds of Roman alum groſsly powdered, and two pounds of red tartar. The whole is brought to boil, and that inſtant the hanks are dipped in (on the ſticks) which are to remain in for two hours, ſtirring them continually one after the other after the method already laid down.

I muſt in this place obſerve, that the liquor in which the alum is put, when on the point of boiling ſometimes riſes ſo ſuddenly that it comes over the copper, if not prevented by adding cold water. If, when it is riſing, the ſpun wool is inſtantly put in, it ſtops it, and produces the ſame effects as cold water.

The liquor does not riſe ſo ſuddenly when there is a large quantity of tartar, as in the proceſs; but when the alum is uſed alone, ſometimes above half the liquor comes over the copper when it begins to boil, if not prevented by the method deſcribed.

When the wool has boiled two hours in this liquor, it is taken out, left to drain, gently ſqueezed, and put into a linen bag in a cool place for five or ſix days, and ſometimes longer; this is called leaving the wool in preparation. This is to make it penetrate the better, and helps to augment the action of the ſalts, for as a part of the liquor always flies off, it is evident that the remaining, being fuller of ſaline particles, becomes more active, provided there remained a ſufficient quantity of humidity; for the ſalts being cryſtalized and dry, would have no more action.

I have dwelled much longer on this preparing liquor, and the method of making it, than I ſhall in the ſequel, as there are a great number of colours for which it is prepared pretty near in the ſame proportion, ſo that when this happens, I ſhall ſlightly deſcribe it, mentioning only the changes that are to be made in the quantity of alum, tartar, ſour water, or other ingredients.

After the ſpun wool has been covered five or ſix days, it is fitted to receive the dye. A freſh liquor is then prepared according to the quantity of wool to be dyed, and when it begins to be lukewarm, take 12 ounces of powdered kermes for each pound of wool to be dyed, if a full and well-coloured ſcarlet is wanted. If the kermes was old and flat, a pound of it would be required to each pound of wool. When the liquor begins to boil, the yarn (ſtill moiſt, which it will be if it has been well wrapped in the bag, and kept in a cool place) is put in. If it had been boiled a long time before, and grown dry, it muſt be lightly paſſed through lukewarm water, and well ſqueezed before it is dyed.

Previous to its being dipped in the copper with the kermes, a handful of wool is caſt in, which is let to boil for a minute: this takes up a kind of black ſcum, which the kermes caſt up, by which the wool that is afterwards dipped acquires a finer colour. This handful of wool being taken out, the prepared is to be put in. The hanks are paſſed on ſticks as in the preparation, continually ſtirring, and airing them one after the other. It muſt boil after this manner an hour at leaſt, then taken out and placed on the poles to drain, afterwards wrung and waſhed.

The dye ſtill remaining in the liquor, may ſerve to dip a little freſh parcel of prepared wool; it will take ſome colour in proportion to the goodneſs and quality of the kermes put into the copper.

When different ſhades are wanted, a leſs quantity of kermes is uſed, ſo that for twenty pounds of prepared wool ſeven or eight are ſufficient.

The quantity of wool that is to have the lighteſt ſhade is firſt to be dipped, and to remain no longer in than the time ſufficient to turn it and make it take the dye equally. Then the next deepeſt ſhade intended is dipped, and left to remain ſome time longer; after this manner the work is continued to the laſt, which is left as long as requiſite to acquire the neceſſary ſhade.

The reaſon of working the lighteſt ſhades firſt, is, that if the yarn is left too long in, no damage is done, as that hank may ſerve for a deeper ſhade; whereas, if they begin by a deeper, there would be no remedy if a failure happened in ſome of the lighter ſhades. The ſame caution is to be taken in all colours whoſe ſhades are to be different.

There are ſeldom more ſhades than one from the colour now ſpoken of; but as the working part is the ſame for all colours, what has been ſaid on this ſubject will ſerve for the reſt.

The yarn thus dyed, before bringing it to the river, may be paſſed through lukewarm water, in which a ſmall quantity of ſoap has been perfectly diſſolved; this gives a brightneſs to the colour, but at the ſame time ſaddens it a little, that is, gives it a little caſt of the crimſon. As I ſhall often make uſe of the terms *rouzing* and *ſaddening*, eſpecially in the acids, it is neceſſary to explain their meaning.

Saddening, is giving a crimſon or violet caſt to red; ſoap and alkaline ſalts, ſuch as ley of aſhes, pot-aſhes, lime, ſadden reds; thus they ſerve to bring them to the ſhade required when too bright, and that they are too much rouzed.

Rouzing, is doing quite the reverſe; it is giving a fire to the red, by making it border on the yellow or orange. This is performed on wool by the means of acids, as red or white tartar, cream of tartar, vinegar, lemon juice, and aqua fortis. Theſe acids are added more or leſs, according to the depth of the orange colour required. For example, if the ſcarlet of grain was wanted to be more bright, and approach ſomewhat nearer to common ſcarlet, a little of the ſcarlet compoſition, which ſhall be ſpoken of, muſt be poured into the liquor after the kermes is put in, and the brown colour of that liquor would immediately be brightened by the acid, and become of a brighter red; the wool dipped in would be more liable to be ſpotted by mud and acid liquors: the reaſon will appear in the next chapter.

I have made various experiments on this colour, in order to make it fitter and brighter than what it generally is, but I never could extract a red that was to be compared to that of cochineal.

Of all the liquors which I made for the preparation of the wool, that which was made with the preparations juſt mentioned ſucceeded beſt. By changing the natural dye of the kermes, by different kinds of ingredients of metallic ſolutions, &c. various colours are made, which I ſhall immediately ſpeak of.

I ſhall ſay but little about dying ſtuffs with this red, as the proportion cannot be preſcribed for each yard of ſtuff, on account of their breadth and thickneſs, or the quantity of wool entering their compoſition; practice alone will teach the neceſſary quantity for each ſort of ſtuff; however, not to work in the dark, or to try experiments at random, the ſureſt way will be to weigh the ſtuffs, and to diminiſh about one-fourth part of the colouring ingredients laid down for ſpun wool, as ſtuffs take up leſs colour inwardly, their texture being more compact, prevents its penetration, whereas yarn or wool in the fleece receives it equally within and without.

The alum and tartar for the liquor of preparation for the ſtuffs muſt be diminiſhed in the ſame proportion, and they are not to remain in the preparing liquor as long as the wool. It may be dyed the next day after boiling.

If wool in the fleece is dyed with the red of the kermes, either to incomparate it with cloths of a mixed colour, or to make full cloths, it will have a much finer effect than if the wool had been dyed in the red of madder. I ſhall mention this in deſcribing the compound colours in which the kermes is uſed, or ought at leaſt to be uſed in preference to madder, which does not give ſo fine a red, but, being cheaper, is commonly ſubſtituted for it.

Half-grain ſcarlet, or baſtard ſcarlet, is that which is made of equal parts of kermes and madder. This mixture affords a very holding colour, not bright, but inclining to a blood red. It is prepared and worked in the ſame manner as that made of kermes alone. This dye is much cheaper, and the Dyers commonly make it leſs perfect by diminiſhing the kermes and augmenting the madder.

By the proofs that have been made of ſcarlet of grain, or kermes, whether by expoſing it to the ſun, or by different proofs, it is certain there is not a more holding or a better colour; yet the kermes is no where in uſe but at Venice. The mode of this colour has been entirely out ſince the making of flame-coloured ſcarlets. This ſcarlet of grain is now called a colour of bullock's blood; nevertheleſs, it has great advantages over the other, for it neither blackens nor ſpots, and greaſe may be taken out without prejudice to its colour; but it is out of faſhion, and that is ſufficient. This has entirely put a ſtop to the conſumption of kermes in France. Scarce a Dyer knows it, and when Monſieur Colbert wanted a certain quantity for the experiments above related, he was obliged to ſend for it to Languedoc, the merchants of Paris keeping only a ſufficiency for medicinal purpoſes.

When a Dyer is obliged to dye a piece of cloth, known yet under the name of ſcarlet of grain, as he has neither the knowledge of the kermes, nor the cuſtom of uſing it, he makes it of a cochineal, as I ſhall relate in the following chapter; it comes dearer, and is leſs holding than that made of the kermes. The ſame is done in regard to ſpun wool deſigned for tapeſtries, and as this ſhade is pretty difficult to hit with cochineal, they commonly mix brazil wood, which hitherto has been a falſe ingredient, permitted only in the leſſer dye. For this reaſon all theſe kind of reds fade in a very ſhort time, and though they are much brighter than required, coming out of the hands of the workman, they loſe all their brightneſs before the expiration of a year; they whiten or become exceeding grey; it is therefore to be wiſhed that the uſe of kermes was again eſtabliſhed. It is alſo certain, that if ſome Dyer ſet about uſing it, there are ſeveral colours that might be extracted from it with more eaſe and leſs expence than the common method; for theſe colours would be better and more holding, and he would thereby acquire a greater reputation. I have made above fifty experiments with the kermes, from which ſome uſe in practice may ariſe; I ſhall only relate ſuch as have produced the moſt ſingular colours.

By mixing the kermes with cream of tartar, without alum, and as much of the compoſition as would be uſed for the making a ſcarlet with cochineal, you have in one liquor an exceeding bright cinnamon, for nothing but the acid entering in the mixture, the red parts of the kermes become ſo minute that they almoſt eſcape the ſight. But if this cinnamon colour be paſſed through a liquor of Roman alum, part of this red appears again; whether it be by the addition of the alum that drives out a part of the acid of the compoſition, or the earth of the alum precipitated by the aſtriction of the kermes, which has the effect of galls, I know not; but this red thus reſtored is not fine.

With cream of tartar (the compoſition for ſcarlet) and alum, in greater quantity than tartar, the kermes gives a lilac colour, which varies according as the proportion of ingredients are changed.

If in the place of alum and tartar, ready prepared tartar of vitriol is ſubſtituted, which is a very hard ſalt, reſulting from the mixture of the vitriolic acid and a fixed alkali, ſuch as the oil of tartar, pot-aſhes, &c. and if, I ſay, after boiling the kermes in a ſolution of a ſmall quantity of this ſalt, the ſtuff be dipped in and boiled one hour, it acquires a tolerable handſome agath grey, and in which very little red is ſeen, for the acid of the compoſition having too much divided the red of the kermes, and the tartar of vitriol, not containing the earth of the alum, it could not re-unite theſe red atoms, diſperſed by precipitation. Theſe agath greys are of the good dye, for, as I have obſerved in the chapter treating of indigo, the tartar of vitriol is a hard ſalt, which is not calcined by the ſun, and is indiſſoluble in rain water.

Glauber ſalts mixed with the kermes entirely deſtroy its red, and give an earthy grey that does not ſtand the proof, for this ſalt neither reſiſts cold water nor the rays of the ſun, which reduce it into powder. Vitriol or green copperas, and blue vitriol ſeparated ſubſtituted for alum, but joined to the cryſtal of tartar, equally deſtroy or veil the red of the kermes, which in theſe two experiments produce the ſame effect as if galls or ſumach had been made uſe of; for it precipitates the iron of the green vitriol, and dyes the cloth of a grey brown, and the copper of the blue vitriol dyes it of an olive.

Inſtead of blue vitriol, I uſed a ſolution of copper* in aqua fortis, which alſo produced an olive colour; a convincing proof that the kermes has the precipitating quality of the galls, ſince it precipitates the copper of the vitriol as a decoction of gall-nut would.

There is great probability that what renders the red of the kermes as holding as that of madder, is from the inſects feeding on an aſtringent ſhrub, which, notwithſtanding the changes made by the digeſtion of the juices of the plant, ſtill retains the aſtringent quality of the vegetable, and conſequently the virtue, and ſo gives a greater ſpring to the pores of the wool to contract themſelves quicker and with greater ſtrength, when it comes out of the boiling water, and is expoſed to the cold air; for I have obſerved that all barks, roots, woods, fruits, and other matters that have ſome aſtriction, yield colours of the good dye.

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* Verdigriſe.

Violets without Blue.

The white vitriol of goſlar, whoſe baſis is the zinck, being joined with the cryſtal of tartar, changes the red of the kermes into a violet. Thus with one colouring ingredient, and ſimple changes, violets are made without a blue ground; for this compound colour, hitherto only obtained by putting a blue on a red, or a red on a blue, is made as well with cochineal, or even with madder, as ſhall be ſhown treating of theſe two ingredients. White vitriol being extracted from a mine, containing lead, arſenic, and ſeveral other matters, whoſe recrements melted afterwards with ſand and alkaline ſalts, vitrifies into a blue maſs, called *ſafre.* I ſuſpected the white vitriol might contain a portion of this blue, which, with the red of the kermes, might have changed to a violet, and conſequently that the mine of the biſmuth, which really contains this blue matter, and the biſmuth itſelf, would produce the ſame effect as white vitriol; neither was I miſtaken in my conjecture; for having put ſome of the extract of the mine of biſmuth in the liquor of kermes, and ſome of the ſolution of the biſmuth itſelf, upon another decoction of the ſame ingredient, they both dyed cloth of a violet colour. I ſhall not here give the proceſs of extracting the mine of biſmuth, for it is a difficult operation for a Dyer. However, if the reader is deſirous to know what I mean by the extraction of the mine of biſmuth, he will find the proceſs in the Royal Academy of Sciences for the year 1737, where there is a memoir on ſympathetic inks. As to the ſolution of biſmuth, which produces almoſt the ſame effect, it is made after the following manner;

Take four parts of ſpirits of nitre, and four parts of very clear water, which mix together, and diſſolve therein one part of biſmuth, or tin glaſs, broken in ſmall pieces, put the laſt little by little into the liquor, leſt they ſhould occaſion too violent a fermentation. Acids put in too great abundance in the liquor of the kermes, whether it be ſpirits of vitriol, aqua fortis, vinegar, lemon juice, even ſour water, ſo greatly divide the red colouring particles, that the cloth receives but a cinnamon colour, bordering on the aurora, if there is too much acid, and a little redder if there is leſs.

Fixed alkaline ſalts, mixed with ſour water and cream of tartar, in the place of alum, do not deſtroy the red of the kermes as acids do, but ſaddens and muds it if too much be put in, ſo that the cloth receives only a faded lilac colour.

Other experiments, ſtill more diverſified than thoſe here related, preſented an infinite variety of colours, but nothing more beautiful than what may be done with cheaper drugs than the kermes; I ſhall therefore paſs them over.

CHAP. X.

OF FLAME-COLOURED SCARLET.

FLAME-coloured ſcarlet, that is, bright-coloured ſcarlet, known formerly under the name of Dutch ſcarlet, (the diſcovery of which Kunkel attributes to Kuſter, a German chymiſt) is the fineſt and brighteſt colour of the dye. It is alſo the moſt coſtly, and one of the hardeſt to bring to perfection. It is not eaſy to determine the point of perfection, for, ſor, independent of different taſtes concerning the choice of colours, there are alſo general fancies, which make certain colours more in faſhion at one time than another; when this happens, faſhionable colours become perfect ones. Formerly ſcarlets were choſen full, deep, and of a degree of brightneſs which the ſight eaſily bore. At this time they muſt be on the orange, full of fire, and of a brightneſs which dazzles the eye. I ſhall not decide which of theſe two faſhions deſerve the preference, but ſhall give the method of making them both, and all the ſhades which hold a medium between theſe extremes.

Cochineal, which yields this beautiful colour, and is alſo called meſtick, or teſcalle, is an inſect that is gathered in great quantities in Mexico. The natives and Spaniards, who have but ſmall eſtabliſhments there, cultivate them, that is, carefully gather them from the plant on which they feed before the rainy ſeaſon. They kill and dry thoſe deſigned for ſale, and preſerve the reſt to multiply when the bad ſeaſon is over. This inſect feeds and breeds upon a kind of prickly opuntia, which they call topal. It may be preſerved in a dry place for ages without ſpoiling.

The cochineal ſylveſtre, or campeſſiane, is alſo brought from Vera-Cruz. The Indians of Old and New Mexico gather this kind in the woods; it feeds, grows, and generates there on the wild uncultivated opuntias; it is there expoſed in the rainy ſeaſon to all the humidity of the air, and dies naturally. This cochineal is always ſmaller than the fine or cultivated; the colour is more holding and better, but has not the ſame brightneſs, neither is it profitable to uſe it, ſince it requires four parts, and ſometimes more, to do what may be done with one of fine.

Sometimes they have damaged cochineal at Cadiz; this is fine cochineal that has been wetted with ſalt water, occaſioned by ſome ſhipwreck or leakage. Theſe accidents conſiderably diminiſh the price, the ſea ſalt ſaddening the dye. This kind ſerves only to make purples, and even thoſe are not the beſt. However, a perſon in 1735 found the ſecret to turn this to almoſt as much advantage for ſcarlet as the fineſt cochineal. The diſcovery of this ſecret is eaſy, but let him that poſſeſſes it enjoy it, I ſhall not deprive him of the advantage he might have in it.

Every Dyer has a particular receipt for dying ſcarlet, and each is fully perſuaded that his own is preferable to all others; yet the ſucceſs depends on the choice of the cochineal, of the water uſed in the dye, and on the manner of preparing the ſolution of tin, which the Dyers call compoſition for ſcarlet.

As it is this compoſition which gives the bright flame colour to the cochineal dye, and which without this acid liquor would naturally be of a crimſon colour, I ſhall deſcribe the preparation that ſucceeded beſt with me.

Compoſition for Scarlet.

Take eight ounces of ſpirit of nitre, (which is always purer than the common aqua fortis moſtly uſed by the Dyers) and * be certain that it con-

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* Diſſolve in a ſmall quantity of ſpirit of nitre as much ſilver as it will take; put a few drops of this into ſome of the ſpirit of nitre that is to be proved; if this ſpirit remains tranſparent, it is pure; but if a white cloud be perceived, which will afterwards form a ſediment, it is a ſign that there is a commixture of vitriol or ſpirit of ſalt. In order therefore to render the ſpirit of nitre abſolutely pure, drop the ſolution of ſilver gradually into it, ſo long

tains no vitriolic acid; weaken this nitrous acid by putting into it eight ounces of filtered river water; diſſolve in it, little by little, half an ounce of very white ſalt ammoniac, to make it an aqua regia, becauſe ſpirits of nitre alone will not diſſolve block-tin. Laſtly, add two drachms of ſaltpetre; this might be omitted, but I obſerved that it was of uſe in making the dye ſmooth and equal. In this aqua regia thus weakened, diſſolve one ounce of the beſt block-tin, which is firſt granulated or made ſmall while melted by caſting it from a height into a veſſel of cold water. Theſe ſmall grains of tin are put into the diſſolvent one by one, letting the firſt diſſolve before putting in others; this prevents the loſs of the red vapours, which would riſe in great abundance, and be loſt if the diſſolution of the metal was made too haſtily; it is neceſſary to preſerve theſe vapours, and, as Kunkel obſerved, they greatly contribute towards the brightneſs of the colour, either becauſe theſe vapours are acids that evaporate and are loſt, or contain a ſulphur peculiar to ſaltpetre, which gives a brightneſs to the colour. This method is indeed much longer than that uſed by the Dyers, who immediately pour the aqua fortis upon the tin reduced to ſmall pieces, and wait till a ſtrong fermentation enſues, and a great quantity evaporates before they weaken it with common water. When the tin is thus diſſolved, this ſcarlet compoſition is made, and the liquor is of the beautiful colour of diſſolved gold, without any dirt or black ſediment,

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as it ſhall produce the leaſt turbidneſs, time being given for the ſpirit to become clear betwixt each addition. The ſpirit of nitre being then poured off from the ſediment, will be perfectly pure; and if this ſediment, which is the ſilver precipitated, be evaporated to dryneſs, and then infuſed in a crucible with a ſmall quantity of any fixed alkaline ſalt, it will be reduced to its proper metalline ſtate.

as I uſed very pure tin without allay, and ſuch as runs from the firſt melting of the furnaces of Cornwall. This ſolution of tin is very tranſparent when newly made, and becomes milky and opaque during the great heat of ſummer; the greateſt part of the Dyers are of opinion, that it is then changed and good for nothing; yet mine, notwithſtanding this defect, made as bright ſcarlet as if it had remained clear; beſides, in cold weather, what I made recovered its firſt tranſparency. It muſt be kept in a glaſs bottle with a ſtopper, to prevent the evaporation of the volatile parts.

As the Dyers do not attend to this, their compoſition often becomes uſeleſs at the end of twelve or fifteen days. I have laid down the beſt method, and, if they ſeek perfection, they will abandon their old practice, which is imperfect.

The Dyers in France firſt put into a ſtone veſſel, with a large opening, two pounds of ſalt ammoniac, two ounces of refined ſaltpetre, and two pounds of tin reduced to grains by water, or, which is ſtill preferable, the filings of tin; for when it has been melted and granulated, there is always a ſmall portion converted into a calx which does not diſſolve. They weigh four pounds of water in a ſeparate veſſel, of which they pour about two ounces upon the mixture in the ſtone veſſel; they then add to it a pound and a half of common aqua fortis, which produces a violent fermentation. When the ebullition ceaſes, they put in the ſame quantity of aqua fortis, and an inſtant after they add one pound more. They then put in the remainder of the four pounds of water they had ſet aſide; the veſſel is then cloſe covered, and the compoſition let to ſtand till the next day.

The ſalt petre and ſalt ammoniac are ſometimes diſſolved in the aqua fortis before the tin is put in;

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they practice both methods indiſcriminately, though it is certain that this laſt method is beſt. Others mix the water and aqua fortis together, and pour this mixture on the tin and ſalt ammoniac. In ſhort, every Dyer follows his own method.

Water for the Preparation of Scarlet.

The day after preparing the compoſition, the water for the preparation of ſcarlet is made, which differs from that made in the preceding chapter.

Clear the water well. For each pound of ſpun wool, put twenty quarts of very clear river water (hard ſpring water will not do) into a ſmall copper. When the water is a little more than lukewarm, two ounces of cream of tartar finely powdered, and one drachm and a half of powdered and ſifted cochineal is added. The fire is then made a little ſtronger, and when the liquor is ready to boil, two ounces of the compoſition are put in. This acid inſtantly changes the colour of the liquor, which, from a crimſon, becomes of the colour of blood.

As ſoon as this liquor begins to boil, the wool is dipped in, which muſt have been previouſly wetted in warm water and wrung. The wool is continually worked in this liquor, and left to boil an hour and a half; it is then taken out, ſlightly wrung, and waſhed in freſh water. The wool coming out of the liquor is of a lively fleſh colour, or even ſome ſhades deeper, according to the goodneſs of the cochineal, and the ſtrength of the compoſition. The colour of the liquor is then entirely paſſed into the wool, remaining almoſt as clear as common water.

This is called the water of preparation for ſcarlet, and the firſt preparation it goes through before it is dyed; a preparation abſolutely neceſſary, without which the dye of the cochineal would not be ſo good.

Reddening.

To finiſh it, a freſh liquor is prepared with clear water, the goodneſs of the water being of the greateſt importance towards the perfection of the ſcarlet. An ounce and a half of ſtarch is put in *, and when the liquor is a little more than lukewarm, ſix drachms and a half of cochineal finely powdered and ſifted is thrown in. A little before the liquor boils, two ounces of the compoſition is poured in, and the liquor changes its colour as in the former. It muſt boil, and then the wool is put into the copper, and continually ſtirred as in the former. It is likewiſe boiled an hour and a half; it is then taken out, wrung, and waſhed. The ſcarlet is then in its perfection.

One ounce of cochineal is ſufficient for a pound of wool, provided it be worked with attention, and after the manner laid down, and that no dye remains in the liquor. For coarſe cloth leſs would do, or half as much for worſted. However, if it was required to be deeper of cochineal, a drachm or two might be added, but not more, for it would then loſe its luſtre and brightneſs.

Though I have mentioned the quantity of the compoſition, both in the water of the preparation and the dye, yet this proportion is not to be taken as a fixed rule.

The aqua fortis, uſed by the Dyers, is ſeldom of an equal ſtrength; if, therefore, it be always mixed with an equal quantity of water, the compoſition would not produce the ſame effect; but there is a method of aſcertaining the degree of acidity

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* Starch ſoftens it.

acidity of aqua fortis. For example, to uſe that only, two ounces of which would diſſolve one ounce of ſilver. This would produce a compoſition that would be always equal, but the quality of the cochineal would then produce new varieties, and the trifling difference that this commonly cauſes in the ſhade of ſcarlet is of no great ſignification, as more or leſs may be uſed to bring it preciſely to the colour deſired. If the compoſition be weak, and the aforeſaid quantity not put in, the ſcarlet will be a little deeper and fuller in colour. On the contrary, if a little more is added, it will be more on the orange, and have what is called more fire; to rectify which, add a little of the compoſition, ſtirring it well in the copper, having firſt taken out the wool; for if it was to touch any part before it was thoroughly mixed, it would blot it. If, on the contrary, the ſcarlet has too much fire, that is, too much on the orange, or too much rouzed, it muſt be paſſed through clear warm water; when finiſhed, this ſaddens it a little, that is, diminiſhes its bright orange; if there ſtill remained too much, a little Roman alum muſt be mixed with the hot water.

For ſpun wool that is to have all the various ſhades of ſcarlet, about half the cochineal, and half the compoſition for full ſcarlet is ſufficient. The cream of tartar muſt alſo be diminiſhed proportionably in the water of preparation. The wool muſt be divided into as many hanks or ſkains as there are to be ſhades, and when the liquor is prepared, the ſkains that are to be lighteſt are firſt to be dipped, and to remain in but a very ſhort ſpace of time; then thoſe that are to be a little deeper, which muſt remain in ſomewhat longer, and thus proceeding to the deepeſt; the wool is then to be waſhed, and the liquor prepared to finiſh them. In this liquor, each of theſe ſhades are to be boiled one after the other, beginning always with the lighteſt, and if any are perceived not to be of the proper ſhade, they muſt be paſſed again through the liquor. The eye of a Dyer will readily judge of the ſhades, and a little practice will bring this to perfection.

The Dyers are divided in opinion of what metal the boiler ſhould be made. In Languedoc they uſe thoſe made of the fineſt block-tin, and ſeveral Dyers in Paris follow the ſame method. Yet that great Dyer, M. de Julienne, whoſe ſcarlets are in high repute, uſes braſs. The ſame is uſed in the great manufactory at St. Dennis. M. de Julienne, to keep the ſtuffs from touching the boiler, makes uſe of a large rope-net with cloſe maſhes. At St. Dennis, inſtead of a rope-net, they have large baſkets, made of willow ſtripped of the bark, and not too cloſe worked.

As ſo much had been ſaid concerning the metal of the boiler, I tried the experiment. I took two ells of white ſedan cloth, which I dyed in two ſeparate boilers of equal ſize; one was of braſs, fitted with a rope-net, the other of block tin. The cochineal, the compoſition, and other ingredients, were weighed with the utmoſt accuracy, and boiled preciſely the ſame time. In ſhort, I took all poſſible care that the proceſs ſhould be the ſame in both, that if any difference aroſe it might only be attributed to the different metals of the boiler. After the firſt liquor, the two pieces of cloth were abſolutely alike, only that which had been boiled in the tin veſſel appeared a little more ſtreaked and uneven, which, in all likelihood, proceeded from theſe two ells of cloth being leſs ſcoured at the mill than the two others; the two pieces were finiſhed each in the ſeparate boilers, and both turned out very fine; but that which had been made in the tin boiler had a little more fire than the other, and the laſt was a little more ſaddened. It would have been an eaſy matter to have brought them both to the ſame ſhade, but that was not my intention.

From this experiment, I conclude, that when a braſs boiler is uſed, it requires a little more of the compoſition than the tin one; but this addition of the compoſition makes the cloth feel rough; to avoid this defect, the Dyers who uſe braſs veſſels put in a little turmeric, a drug of the Dye, but which gives to ſcarlet that ſhade which is now in faſhion; I mean that flame-colour, which the eye is ſcarce able to bear.

This adulteration is eaſily diſcovered by cutting a piece of the cloth; if there is no turmeric, the web will be of a fine white, but yellow if there is. When the web is dyed the ſame as the ſurface, it is ſaid that colour is webbed, and the contrary, when the middle of the weaving remains white. The lawful ſcarlet is never dyed in the web: the adulterated, where the turmeric or fuſtic has been made uſe of, is more liable to change its colour in the air than the other. But as the brighteſt ſcarlets are now in faſhion, and muſt have a yellow caſt, it is better to tolerate the uſe of turmeric, than to uſe too great a quantity of the compoſition to bring the ſcarlet to this ſhade; for in this laſt caſe, the cloth would be damaged by it, would be ſooner ſpotted by dirt from the quality of the acid, and would be more eaſily torn, becauſe acids ſtiffen the fibres of the wool, and render them brittle.

I muſt alſo take notice, that if a copper veſſel is uſed it cannot be kept too clean. I have failed ſeveral times with my patterns of ſcarlet, by not having the copper ſcoured.

I cannot help condemning the common practice of ſome Dyers, even the moſt eminent, who prepare their liquor over-night, and keep it hot till next morning, when they dip in their ſtuffs; this they do not to loſe time, but it is certain that the liquor corrodes the copper in that ſpace, and by introducing particles of copper in the cloth, prejudices the beauty of the ſcarlet. They may ſay they only put in their compoſition juſt at the time when the cloth is ready to be dipt in the copper; but the cream of tartar, or the white tartar, which they put in over-night, is an acid ſalt ſufficient to corrode the copper of the veſſel, and form a verdigriſe, although it dilutes itſelf as it forms, ſtill has not a leſs effect.

It would therefore be better to make uſe of tin boilers, a boiler of this metal muſt contribute to the beauty of ſcarlet; but theſe boilers of a ſufficient ſize coſt much, and may be melted by the negligence of the workmen, and there is a difficulty in caſting them of ſo great a ſize without ſand-flaws, which muſt be filled. Now if theſe ſand-holes are filled with ſolder, there muſt of neceſſity be places in the boiler that contain lead; this lead in time being corroded by the acid of the compoſition, will tarniſh the ſcarlet. But if ſuch a boiler could be caſt without any ſand-holes, it is certain ſuch a one would be preferable to all others, as it contracts no ruſt, and if the acid of the liquor detaches ſome parts, they cannot be hurtful.

Having laid down the manner of dying ſpun wool in ſcarlet, and its various ſhades, which are ſo neceſſary for tapeſtry and other work, it is proper to give an idea of the dying of ſeveral pieces of ſtuff at one time. I ſhall relate this operation as it is practiſed in Languedoc. I made the trial on ſome ells of ſtuff, which ſucceeded very well, but this ſcarlet was not ſo fine as the flame-coloured.

There are two reaſons why the wool is not dyed before it is ſpun (for fine colours) firſt in the courſe of the manufacturing, that is, either in the ſpinning, carding, or weaving, it would be almoſt impoſſible in a large workſhop, where there are many workmen, but that ſome particles of white wool, or ſome other colour would mix, which would ſpoil that of the ſtuff by blotting it ever ſo little; for that reaſon, the reds, the blues, the yellows, the greens, and all other colours that are to be perfectly uniform, are never dyed before they are manufactured.

The ſecond reaſon, which is peculiar to ſcarlet, or rather to cochineal, is, that it will not ſtand the milling, and as the greateſt part of high ſtuffs muſt be milled after they are taken from the loom, the cochineal would loſe part of its colour, or at leaſt would be greatly ſaddened by the ſoap, which produces this effect by the alkaline ſalt which deſtroys the brightneſs given to the red by the acid. Theſe are the reaſons that the cloths and ſtuffs are not dyed in ſcarlet, light red, crimſon, violet, purple, and other light colours, but after being entirely milled and dreſſed.

To dye, for example, five pieces of cloth at one time of five quarters breadth, and containing fifteen or ſixteen ells each, the following proportions are to be obſerved. Put into a ſtone or glazed earthen pot twelve pounds of aqua fortis, and twenty pounds of water, to which add a pound and a half of tin, made in grains by running it in water, or filed. The diſſolution is made quicker or ſlower, according to the greater or leſſer acidity of the aqua fortis. The whole is left to reſt twelve hours at leaſt, during which time a kind of black mud ſettles at the bottom of the veſſel; what ſwims over this ſediment is poured off by inclination; this liquor is clear and yellow, and is the compoſition which is to be kept by itſelf.

This proceſs differs from the firſt in the quantity of water mixt with the aqua fortis, and in the ſmall quantity of tin, little of which muſt remain in the liquor, ſince aqua fortis alone cannot diſſolve it, but only corrodes it, and reduces it to a calx, as there is neither ſalt petre, nor ſalt ammoniac which would form an aqua regia. However, the effect of this compoſition differs from the firſt only to the eyes accuſtomed to judge of that colour.

This compoſition made without ſalt ammoniac, and which has been of long uſe amongſt a great number of manufacturers at Carcaſſone, who certainly imagined that its effect was owing to the ſulphur of the tin, can only keep thirty-ſix hours in winter without ſpoiling, and twenty-four hours in ſummer; at the expiration of which it grows muddy, and a cloud precipitates to the bottom of the veſſel, which changes to a white ſediment. This is the ſmall quantity of tin, which was ſuſpended in the acid, but an acid not prepared for that metal; the compoſition which ought to be yellow becomes at that time as clear as water, and if uſed in that ſtate would not ſucceed; it would have the ſame effect as that which would become milky.

The late M. Baron pretended to have been the firſt diſcoverer at Carcaſſone of the neceſſity of adding ſalt ammoniac to hinder the tin from precipitating. If ſo, there was no one in that town that knew that tin cannot be really diſſolved but by aqua regia.

Having prepared the compoſition as I have deſcribed it after M. de Fondriers, about ſixty cubical feet of water are put into a large copper for the five pieces of cloth before mentioned, and when the water grows warm, a bag with bran is put in, ſometimes alſo ſour waters are uſed: the one and the other ſerve to correct the water, that is, to abſorb the earthy and alkaline matters which may be in it; and which, as I have already ſaid, ſaddens the dye of the cochineal, for the effect of the water ought to be well known, and experience will teach whether ſuch expedients ſhould be uſed, or whether the water, being very pure and denulated of ſalts and earthy particles, can be uſed without ſuch helps.

Be that as it will, as ſoon as the water begins to be little more than lukewarm, ten pounds of powdered cream of tartar is flung in, that is, two pounds for each piece of cloth. The liquor is then raked ſtrongly, and when it grows a little hotter, half a pound of powdered cochineal is caſt in, which is well mixt with ſticks; immediately after, twenty-ſeven pounds of the compoſition very clear is poured in, which is alſo well ſtirred, and as ſoon as the liquor begins to boil, the cloths are put in, which are made to boil ſtrongly for two hours, ſtirring them continually by the help of the wynch; they are then taken out upon the ſcray, and well handled three or four times from end to end, by paſſing the liſts between the hands to air and cool them. They are afterwards waſhed.

After the cloth has been waſhed, the copper is emptied and a freſh liquor prepared, to which, if neceſſary, a bag with bran or ſome ſour water is added; but if the water is of a good quality, theſe are to be omitted; when the liquor is ready to boil, eight pounds and a quarter of powdered and ſifted cochineal is put in, which is to be mixed as equally as poſſible throughout the liquor, and having left off ſtirring, it is to be obſerved when the cochineal riſes on the ſurface of the water, and forms a cruſt of the colour of the lees of the wine; the inſtant this cruſt opens of itſelf in ſeveral places, eighteen or twenty pounds of the compoſition is to be added. A veſſel with cold water muſt be at hand to caſt on the liquor in caſe it ſhould riſe, as it ſometimes does, after the compoſition is put in.

As ſoon as the compoſition is in the copper, and equally diſtributed throughout the whole, the cloth is caſt in, and the wynch ſtrongly turned two or three times, that all the pieces may equally take the dye of the cochineal. Afterwards it is turned ſlowly to let the water boil, which it muſt do very faſt for one hour, always turning the wynch, and ſinking the cloth in the liquor with ſticks, when by boiling it riſes too much on the ſurface. The cloth is then taken out, and the liſts paſſed between the hands to air and cool it; it is then waſhed, after which it is to be dyed and dreſſed.

In each piece of the Languedoc ſcarlet cloth there is uſed, as has been ſhown, one pound and three quarters of cochineal in the dye and preparation; this quantity is ſufficient to give the cloth a very beautiful colour. If more cochineal was added, and a deeper orange-colour required, the quantity of the compoſition muſt be augmented.

When a great quantity of ſtuffs are to be dyed in ſcarlet, a conſiderable profit ariſes by doing them together, for the ſame liquor ſerves for the ſecond dip which was uſed for the firſt. For example: when the five firſt pieces are finiſhed, there always remains in the liquor a certain quantity of cochineal, which in ſeven pounds may amount to twelve ounces; ſo that if this liquor be uſed to dye other ſtuffs, the cloths dipped in it will have the ſame ſhade of roſe colour as if they had been dyed in a freſh liquor with twelve ounces of cochineal; yet this quantity may vary pretty much, according to the quality or choice of the cochineal, or according to the fineneſs it has been reduced to when powdered. I ſhall ſay no more of this before I finiſh this chapter; but whatever colour may remain in the liquor, it deſerves ſome attention on account of the high price of this drug. The ſame liquor is then made uſe of for other five pieces, and leſs cochineal and compoſition are put in proportion to what may be judged to remain; fire and time are alſo ſaved by this, and roſe-colour and fleſh-colour may alſo be produced from it; but if the Dyers have no leiſure to make theſe different liquors in twenty four hours, the colour of the liquor corrupts, grows turbid, and loſes the roſe-colour entirely. To prevent this corruption ſome put in Roman alum, but the ſcarlets which are prepared after that manner are all ſaddened.

When cloths of different qualities, or any other ſtuffs are to be dyed, the ſureſts method is to weigh them, and for each hundred weight of cloth add about ſix pounds of cryſtal or cream of tartar, eighteen pounds of compoſition in the water of preparation, as much for the reddening, and ſix pounds and a quarter of cochineal. Thus in proportion for one pound of ſtuff uſe one ounce of cream of tartar, ſix ounces of compoſition, and one ounce of cochineal; ſome eminent Dyers at Paris put two-thirds of the compoſition and a fourth of the cochineal in the water of preparation, and the other third of the compoſition with three-fourths of the cochineal in reddening.

It is not cuſtomary to put cream of tartar in the reddening, yet I am certain, by experience, that it does not hurt, provided the quantity does not exceed half the weight of the cochineal, and it appeared to me to make a more laſting colour. Some Dyers have made ſcarlet with three dippings;

namely, a firſt and ſecond water for preparation, and then the reddening; but ſtill the ſame quantity of drugs is always uſed.

I obſerved, in the foregoing chapter, that the little uſe made of kermes for the brown or Venetian ſcarlets, obliges moſt Dyers to make them with cochineal; for this purpoſe a water of preparation is made as uſual; and for the reddening, eight pounds of alum are added for each hundred weight of ſtuff; this alum is diſſolved by itſelf in a kettle, with a ſufficient quantity of water, then poured into the liquor before the cochineal is put in. The remainder is performed exactly as in the common ſcarlet; this is the Venetian ſcarlet, but it has not near the ſame ſolidity as if made with the kermes.

There are no alkaline ſalts which do not ſadden ſcarlet; of this number are the ſalt of tartar, pot-aſh, pearl-aſhes calcined, and nitre fixed by fire; therefore alum is more generally uſed; and if theſe alkaline ſalts be boiled with the ſtuffs, they would conſiderably damage them, for they diſſolve all animal ſubſtances. If the alum be calcined, it is ſtill the more ſecure.

The redder the ſcarlet is, the more it has been ſaddened; from thence it appears that theſe colours loſe in the liquor that browns them a part of their ground; however one cannot brown in the good dye but with ſalts. The late M. Baron obſerves, in a memoir he gave ſome time ago to the Royal Academy of Sciences, that all the ſalts he had made uſe of for browning, making the colour ſmooth, and preſerving its brightneſs and deepneſs, he had ſucceeded beſt with ſalt of urine, but, as he obſerves, it is too troubleſome to make this ſalt in any quantity.

I ſaid, in the beginning of this chapter, that the choice of the water for dying of ſcarlet was very material, as the greateſt part of common water ſaddens it, for they moſtly contain a chalky, calcarious earth, and ſometimes a ſulphureous or vitriolic acid; theſe are commonly called hard waters, that is, they will not diſſolve ſoap or boil vegetables well. By finding a method of abſorbing or precipitating theſe hurtful matters, all waters may be equally good for this kind of dye: thus, if alkaline matters are to be removed, a little ſour water produces this effect; for if five or ſix buckets of theſe ſour waters are mixed with ſixty or ſeventy of the hard water before it comes to boil, theſe alkaline earths riſe in a ſcum, which is eaſily taken off the liquor.

All that I have hitherto ſaid in this chapter is for the inſtruction of Dyers; I ſhall now make an attempt to ſatisfy the philoſopher how theſe different effects are produced.

Cochineal, infuſed or boiled by itſelf in pure water, gives a crimſon colour bordering on the purple; this is its natural colour; put it into a glaſs, and drop on it ſpirits of nitre; this colour will become yellow, and if you ſtill add more, you will ſcarcely perceive that there was originally any red in the liquor; thus the acid deſtroys the red by diſſolving it and dividing its parts ſo minutely that they eſcape the ſight. If in this experiment a vitriolic, inſtead of a nitrous acid be uſed, the firſt changes of the colour will be purple, then purpled lilac, after that a light lilac, then fleſh-colour, and laſtly, colourleſs. This bluiſh ſubſtance, which mixes with the red to form a purple, may proceed from that ſmall portion of iron, from which oil of vitriol is rarely exempt. In the liquor of preparation for ſcarlet, no other ſalt but cream of tartar is uſed, no alum is added as in the common preparing water for other colours, becauſe it would ſadden the dye by its vitriolic acid; yet a calx or lime is required, which, with the red parts of the cochineal, may form a kind of lake like that the painters uſe, which may ſet in the pores of the wool by the help of the cryſtal of tartar.

This white calx is found in the ſolution of very pure tin, and if the experiment of the dye is made in any ſmall glazed earthen veſſel, immediately on the cochineal's communicating its tincture to the water, and then adding the compoſition drop by drop, each drop may be perceived with a glaſs or lens, to form a ſmall circle, in which a briſk fermentation is carried on; the calx of the tin will be ſeen to ſeparate, and inſtantaneouſly to take the bright dye, which the cloth will receive in the ſequel of the operation.

A further proof that this white calx of tin is neceſſary in this operation, is, that if cochineal was uſed with aqua fortis, or ſpirits of nitre alone, a very ugly crimſon would be obtained; if a ſolution of any other metal was made uſe of in ſpirits of nitre, as of iron or mercury, from the firſt would be had a deep cinder-grey, and from the ſecond, a cheſnut colour with green ſtreaks, without being able to trace in the one or other any remains of the red of the cochineal. Therefore, by what I have laid down, it may be reaſonable to ſuppoſe, that the white calx of the tin, having been dyed by the colouring parts of the cochineal, rouzed by the acid of the diſſolvent of this metal, has formed this kind of earthy lake, whoſe atoms have introduced themſelves into the pores of the wool, which were opened by the boiling water, that they are there plaiſtered by the cryſtal of tartar, and theſe pores, ſuddenly contracting by the immediate cold the cloth was expoſed to by airing, that theſe colouring particles are found ſufficiently ſet in to be of the good dye, and that the air will take off the primitive brightneſs, in proportion to the various matters with which it is impregnated. In the country, for example, and particularly if the ſituation be high, a ſcarlet cloth preſerves its brightneſs much longer than in great cities, where the urinous and alkaline vapours are more abundant. For the ſame reaſon, the country mud, which in roads is generally but an earth diluted by rain water, does not ſtain ſcarlet as the mud of towns where there are urinous matters, and often a great deal of diſſolved iron, as in the ſtreets of great cities, for it is well known that any alkaline matter deſtroys the effect which an acid has produced on any colour whatſoever. And for the like reaſon, if a piece of ſcarlet is boiled in a ley of pot-aſh, this colour becomes purple, and by a continuation of boiling it is entirely taken out; thus from this fixed alkali, and the cryſtal of tartar, a ſoluble tartar is made, which the water diſſolves and eaſily detaches from the pores of the wool: all the maſtic of the colouring parts is then deſtroyed, and they enter into the leys of the ſalts.

I have tried ſeveral experiments on the dye of cochineal, to diſcover what might be produced from the union of its red with other different matters, which generally are not eſteemed colouring; but I ſhall only relate here ſuch as had the moſt ſingular effects.

Experiments on Cochineal Liquor.

Zinc diſſolved in ſpirit of nitre changes the red of cochineal to a ſlatey violet-colour.

The ſalt of lead, uſed inſtead of cream of tartar, makes a lilac ſomewhat faded; a proof that ſome portion of lead is joined to the colour of the cochineal.

Vitriolated tartar made with pot-aſh and vitriol deſtroys its red, and there only remains an agath grey.

Diſmuth diſſolved in ſpirit of nitre, weakened by an equal part of common water, and poured on the liquor of cochineal, gives the cloth a dove-grey, very beautiful and very bright.

A ſolution of copper in ſpirit of nitre not weakened, gives to the cochineal a dirty crimſon.

Cupullated ſilver, a cinnamon colour, a little on the brown.

Arſenic added to the liquor of cochineal, gives a brighter cinnamon than the preceding.

Gold diſſolved in aqua regia gave a ſtreaked cheſnut, which made the cloth appear as if it had been manufactured with wool of different colours.

Mercury diſſolved with ſpirit of nitre, produces pretty near the ſame effect.

Glauber's ſalts alone deſtroys the red, like the vitriolated tartar, and produces like that an agath grey, but not of the good dye; becauſe this ſalt eaſily diſſolves even in cold water, and beſides it calcines in the air.

The fixed ſalt of urine gives a cinder-grey colour, where not the leaſt tincture of red is perceived, and like the foregoing is not of a good dye, for it is a ſalt that cannot form a ſolid cement in the pores of the wool, as it is ſoluble by the moiſture of the air.

Violet without Blue.

Laſtly, the extract of buſmuth changes the cochineal red to a purple, almoſt violet, as beautiful as if this red had been put on a cloth that had been previouſly dyed of a ſky-blue.

From theſe experiments it is evident, that the ſalts and metallic ſolutions yield particles which unite themſelves with the particles of the colouring ingredients uſed in dying, and which ſalts and particles contribute greatly to the tenacity of colours.

Before I finiſh this chapter on ſcarlet, I muſt add ſome obſervations which perhaps the reader may be glad to know.

Neither the mud of the ſtreets nor ſeveral acrid matters can ſtain ſcarlet, if the ſpotted part is immediately waſhed with plain clean water and a clean cloth; but if the mud has had time to dry, then the ſpot appears of a violet black; this cannot be taken off but by a vegetable acid, ſuch as vinegar, lemon-juice, or a warm ſolution of white tartar ſlightly loaded with ſalts; but if theſe acids are not made uſe of with precaution and ſkill in taking off the black ſpot, a yellow one will ſucceed; becauſe, as has been ſaid before, the acids rouſe and even deſtroy the red of the cochineal.

But there are ſome for which the colour muſt be diſcharged, and the ſtuff dyed again. There are other ſalts, beſides alkalis which will diſcharge the colour of ſcarlet; for if a piece of ſcarlet cloth be put into the water of preparation for that colour, it will loſe a great part of its colour, inſomuch, that if it was ſewed with two or three pieces of white cloth, it would be difficult after one hour's boiling to diſtinguiſh which was the ſcarlet from the others; but if it was boiled afreſh in a liquor, of cochineal or in the reddening, it would regain its firſt colour.

Scarlets always loſe ſome part of their brightneſs in the dreſſing, for the dreſſing lays the hair, and forces the fibres to be almoſt parallel to the web. In this caſe the cloth has numerically leſs ſurface, and conſequently leſs rays of light are reflected from it. Beſides the extremity of the hair i is always moſt penetrated with the dye which cauſes the brightneſs, and when it is laid on the cloth, the greateſt part of theſe points appear no more.

CHAP. XI.

OF CRIMSON.

CRIMSON, as I have already obſerved, is the natural colour of the cochineal, or rather, that which it gives to wool boiled with alum and tartar, which is the uſual water of preparation for all colours. This is the method which is commonly practiſed for ſpun wool; it is almoſt the ſame for cloths, as will be ſeen hereafter.

For each pound of wool, two ounces and a half of alum, and an ounce and a half of white tartar, are put into the copper. When the whole boils, the wool is put in, well ſtirred, and left to boil for two hours; it is afterwards taken out, ſlightly wrung, put into a bag, and left thus with its water, as for the ſcarlet in grain, and for all other colours.

For the dye a freſh liquor is made, in which three-fourths of an ounce of cochineal is added for each pound of wool. When the liquor is little more than luke-warm, the cochineal is put in, and when it begins to boil, the wool is caſt in, which is to be well ſtirred with ſticks; it is to remain thus for an hour; when taken out, wrung and waſhed.

If degrees of ſhades are required, (whoſe names are merely arbitrary) proceed, as has been already related for the ſcarlet, uſing but half the cochineal at firſt, and beginning with the lighteſt.

The beauty of crimſon conſiſts in its bordering as much as poſſible on the griſdelin, a colour between a grey and a violet. I made ſeveral trials to bring crimſon to a higher perfection than moſt Dyers have hitherto done, and indeed I ſucceeded ſo as to make it as fine as the falſe crimſon, which is always brighter than the fine.

This is the principle on which I worked. As all alkalis ſadden cochineal, I tried ſoap, barilla, pot-aſh, pearl-aſhes; all theſe ſalts brought the crimſon to the ſhade I wanted, but at the ſame time, they tarniſhed and diminiſhed its brightneſs. I then bethought myſelf to make uſe of volatile alkalis, and I found that the volatile ſpirit of ſalt ammoniac produced a very good effect; but this ſpirit inſtantly evaporated, and a pretty conſiderable quantity was uſed in the liquor, which greatly augmented the price of the dye.

I then had recourſe to another expedient which ſucceeded better, the expence of which is trifling. This was to make the volatile alkali of the ſalt ammoniac enter into the liquor, at the very inſtant that it comes out of its baſis; and to effect this, after my crimſon was made after the uſual manner, I paſſed through a freſh liquor, in which I had diſſolved a little of the ſalt ammoniac. As ſoon as the liquor was a little more than luke-warm, I flung in as much pot-aſh as I had before of ſalt ammoniac, and my wool immediately took a very brilliant colour.

This method even ſpares the cochineal; for this new liquor makes it riſe, and then leſs may be uſed than in the common proceſs; but the greateſt part of Dyers, even the moſt eminent, ſadden their crimſons with archil, a drug of the falſe dye.

Very beautiful crimſons are alſo made by boiling the wool as for the common ſcarlet, and then boiling it in a ſecond liquor, whith two ounces of alum and one ounce of tartar, for each pound of wool, leaving it one hour in the liquor. A freſh liquor is then prepared, in which ſix drachms of cochineal is put for every pound of wool. After it has remained an hour in this liquor, it is taken out, and paſſed immediately through a liquor of barilla and ſalt ammoniac. By this method, gradations of very beautiful crimſon ſhades are made by diminiſhing the quantity of the cochineal. It is to be obſerved, that in this proceſs there are but ſix drachms of cochineal to dye each pound of wool, becauſe in the firſt liquor a drachm and a half of cochineal is uſed for each pound. It is alſo neceſſary to remark, that, to ſadden theſe crimſons, the liquor of the alkaline ſalt and ſalt ammoniac be not made too hot, becauſe the ſeparation of the volatile ſpirit of this laſt ſalt would be too quick, and the cryſtal of tartar of the firſt liquor would loſe its proper effect by being changed, as I have already ſaid into a ſoluble tartar.

The ſame operation may be done by uſing one part of the cochineal ſylveſtre inſtead of the fine cochineal, and the colour is not leſs beautiful, for commonly four parts of ſylveſtre have not more effect in dying than one part of fine cochineal. The ſylveſtre may alſo be uſed in dying ſcarlet, but with great precaution; it ſhould only be uſed in baſtard ſcarlets and half crimſons. I ſhall ſpeak of this when I treat of theſe colours in particular.

When a ſcarlet is ſpotted or ſpoiled in the operation, by ſome unforeſeen accident, or even when the dye has failed, the common remedy is to make it a crimſon, and for that purpoſe, it is dipt in a liquor where about two pounds of alum are added for each hundred weight of wool. It is immediately plunged in this liquor, and left there until it has acquired the ſhade of the crimſon deſired.

Languedoc Crimſon.

I ſhall now ſhow the method they follow in Languedoc to make a very beautiful ſort of crimſon, or the cloths exported to the Levant, but which is not ſo much ſaddened as that which I have juſt ſpoken of, and which reſembles much more the Venetian ſcarlet. For five pieces of cloth the liquor is prepared as uſual, putting bran if neceſſary. When it is more than lukewarm, ten pounds of ſea-ſalt are put, inſtead of cryſtal of tartar, and when it is ready to boil, twenty-ſeven pounds of the ſcarlet compoſition, made after the manner of carcaſſine already deſcribed, are poured in, and without adding cochineal the cloth is paſſed through this liquor for two hours, keeping it always turning with the wynch, and continually boiling. It is afterwards taken out, aired and waſhed; then a freſh liquor is made, with eight pounds and three quarters of cochineal powdered and ſifted, and when it is ready to boil, twenty-one pounds of compoſition are added; the cloth is boiled for three quarters of an hour with the common precautions, after which it is taken out, aired and waſhed: It is of a very fine crimſon, but very little ſaddened; if it is required to be more ſaddened, a greater quantity of alum is put into the firſt liquor of preparation, and in the ſecond leſs of the compoſition, the ſea-ſalt is alſo added to this ſecond liquor; a little practice in this method will ſoon teach the Dyer to make all the ſhades that can properly be derived from crimſon.

Whenever cochineal has been uſed, there is found at the bottom of the reddening liquor a quantity of very brown ſediment, which is flung away with the liquor as uſeleſs. I examined it and found, that the liquor for the reddening of ſcarlet contained a precipitated calx of tin: I united this metal with a great deal of trouble; the remaining parts of this ſediment are the droſs of the white tartar, or of the cream of tartar, united with the groſs parts of the bodies of the cochineal, which is, as has already been ſaid, a ſmall inſect. I waſhed theſe little animal parts in cold water, and, by ſhaking this water, I collected, with a ſmall ſieve, what the agitation cauſed to riſe on the ſurface.

After this manner I ſeparated theſe light parts from the earthy and metallic; I dried them ſeparately, then levigated them with equal weight of freſh cryſtal of tartar; I boiled a portion with a little alum, and put in a pattern of white cloth, which boiled for three quarters of an hour, at the end of which it was dyed of a very beautiful crimſon.

This experiment having convinced me, that by powdering and ſifting the cochineal as is commonly practiſed, all the profit that might be extracted from this dear drug is not obtained, I thought proper to communicate this diſcovery to the Dyers, that they might avail themſelves of it by the method following.

Take one ounce of cochineal powdered and ſifted as uſual; mix with it a quarter of its weight of very white cream of tartar very cryſtalline and very airy; put the whole on a hard levigating ſtone, and levigate this mixture till it is reduced to an impalpable powder; make uſe of this cochineal thus prepared in the liquor, and in the reddening, ſubtracting from the cream of tartar, which is to be uſed in the liquor, the ſmall quantity before uſed with the cochineal. What is put to the reddening, although mixed with a fourth of the ſame ſalt, does not prejudice its colour, it even appeared to me that it was more ſolid. Thoſe that will follow this method will find that there is about a fourth more profit to be obtained by it.

The Natural Crimſon in Grain.

In proportion for every pound of cloth or other things, take two ounces of tartar pure, and two ounces of alum; boil them with the goods an hour and a half; then rince the goods very well from the boiling. The kettle muſt be filled again with clear water and a few handfuls of bran put in, in order to take out the filth of the water, as well as to ſoften it. Scum the ſcurf off when it begins to boil, and put in an ounce of well-powdered grain, with one dram of red arſenic and one ſpoonful of burnt wine lees; this gives a pretty luſtre; then waſh and rince it well, and you have a moſt beautiful colour.

CHAP. XII.

SCARLET OF GUM-LACQUE.

THE red part of the gum-lacque may be alſo uſed for the dying of ſcarlet, and if this ſcarlet has not all the brightneſs of that made of fine cochineal alone, it has the advantage of being more laſting.

The gum-lacque, which is in branches or ſmall ſticks and full of animal parts, is the fitteſt for dying.

ing. It muſt be red within, and its external parts of a blackiſh brown; it appears, by a particular examination made of it by M. Geoffroy ſome years ſince, that it is a ſort of hive, ſomewhat like that of bees, waſps, &c.

Some Dyers make uſe of it powdered and tied in a linen bag; but this is a bad method, for there always paſſes through the cloth ſome reſinous portion of the gum, which melts in the boiling water of the copper, and ſticks to the cloth, where it becomes ſo adherent when cold, that it muſt be ſcraped off with a knife.

Others reduce it to powder, boil it in water, and after it has given all its colour, let it cool, and the reſinous parts fall to the bottom. The water is poured out, and evaporated by the air, where it often becomes ſtinking, and when it has acquired the conſiſtence of thick honey, it is put up into veſſels for uſe. Under this form it is pretty difficult juſtly to determine the quantity that is uſed; this induced me to ſeek the means of obtaining this tincture ſeparated from its reſinous gum, without being obliged to evaporate ſo great a quantity of water to have it dry, and to reduce it to powder.

I tried it with weak lime water, with a decoction of the heart of agaric, with a decoction of comfrey-root, recommended in an ancient book of phyſic; in all theſe the water leaves a part of the dye, and it ſtill paſſes too full of colour, and it ought to be evaporated to get all the dye; this evaporation I wanted to avoid, therefore I made uſe of mucilaginous or ſlimy roots, which of themſelves gave no colour, but whoſe mucilage might retain the colouring parts, ſo that they might remain with it on the filter.

The great comfrey-root has, as yet, the beſt anſwered my intention: I uſe it dry and in a groſs powder, putting half a dram to each quart of water, which is boiled a quarter of an hour, paſſing it through a hair ſieve. It immediately extracts from it a beautiful crimſon tincture; put the veſſel to digeſt in a moderate heat for twelve hours, ſhaking it ſeven or eight times to mix it with the gum that remains at the bottom, then pour off the water that is loaded with colour in a veſſel ſufficiently large, that three-fourths may remain empty, and fill it with cold water: then pour a very ſmall quantity of ſtrong ſolution of Roman alum on the tincture; the mucilaginous or ſlimy dye precipitates itſelf, and if the water which appears on the top appears ſtill coloured, add ſome drops of the ſolution of alum to finiſh the precipitation, and this repeat till the water becomes as clear as common water.

When the crimſon mucilage or ſlime is all ſunk to the bottom of the veſſel, draw off the clear water, and filter the remainder; after which, dry it in the ſun.

If the firſt mucilaginous water has not extracted all the colour of the gum-lacque, (which is known by the remaining being of a weak ſtraw colour) repeat the operation until you ſeparate all the dye the gum-lacque can furniſh; and as it is reduced to powder when dry, the quantity to be uſed in the dye is more exactly aſcertained than by evaporating it to the conſiſtence of an extract.

Good gum-lacque, picked from its ſticks, yields, dried and powdered, but little more dye than one-fifth of its weight. Thus at the price it bears at preſent, there is not ſo great an advantage as many may imagine in uſing it in the place of cochineal; but to make the ſcarlet colour more laſting than it commonly is, it may be uſed in the firſt liquor or preparation, and cochineal for reddening.

If ſcarlet is made of gum-lacque, extracted according to the method here taught, and reduced to powder, a caution is to be taken in diſſolving it, which is uſeleſs when cochineal is uſed; that is, if it was put into the liquor ready to boil, the Dyer would loſe three quarters of an hour, before it would be diſſolved entirely; therefore for deſpatch, put the doſe of this dry tincture into a large earthen veſſel, or into one of tin, pour warm water on it, and when it is well moiſtened, add the neceſſary doſe of the compoſition for ſcarlet, ſtirring the mixture well with a glaſs peſtle. This powder, which was of a dirty deep purple, as it diſſolves takes fire-coloured red extremely bright; pour the diſſolution into the liquor, in which was previouſly put the cryſtal of tartar, and as ſoon as this liquor begins to boil, dip the cloth in, keeping it continually turning. The remaining part of the operation is the ſame as that of ſcarlet with cochineal: the extract of gum-lacque, prepared according to my method, yields about one-ninth more of dye than cochineal, at leaſt than that which I made uſe of for this compariſon.

If inſtead of the cryſtal of tartar and the compoſition of ſome fixt alkaline ſalt or lime water is ſubſtituted, the bright red of the gum-lacque is changed into the colour of lees of wine, ſo that this dye does not ſadden ſo eaſily as that of cochineal.

If inſtead of theſe alteratives, ſalt ammoniac is uſed by itſelf, cinnamon or clear cheſnut colours are obtained, and that according as there is more or leſs of this ſalt. I have made twenty other experiments on this drug, which I ſhall not relate here, becauſe they produced none but common colours, and which may be eaſier had from ingredients of a lower price. My experiments were with a view of improving the red of the lacque, and the method I have here laid down to extract its colouring parts anſwers extremely well; the more ingredients that are diſcovered for ſcarlet, the leſs will be the coſt; for, although theſe experiments made on cochineal, lacque, and other drugs, may appear uſeleſs to ſome Dyers, they will not be ſo to others who ſtudy to improve this art*.

CHAP. XIII.

OF THE COCCUS POLONICUS, A COLOURING INSECT.

THE *coccus polonicus* is a little round inſect, ſomewhat leſs than a coriander ſeed; it is found ſticking to the roots of the *polygonum cocciferum incanum flore majore perenni* of Ray, and which M. Tournefort has named *alchymilli graminco foliis majore flore.* According to M. Breyn, it abounds in the palatinate of Kiovia, bordering the Ukrania, towards the towns of Ludnow, Piatka, Stobdyzeze, and other ſandy places of Ukrania and Podolia, of Volhinia, of the grand duchy of Lithuania, and even in Pruſſia, towards Thorn.

Thoſe that gather them ſay, that immediately after the ſummer ſolſtice the coccus is ripe, and full of its purple juice. They hold in their hand a ſmall hollow ſhade, made in the ſhape of a ſhepherd's crook, which has a ſhort handle. With one hand they hold the plant, raiſing it out of the ground with the other, armed with this inſtrument; they then ſhake off theſe little inſects, and place the plant in the ſame hole in order to preſerve it.

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* The colouring parts of the gum-lacque may be extracted by common river water, by making it a little more than luke-warm, and incloſing the powdered lacque in a coarſe woollen bag.

Having ſeparated the coccus from the earth, which they do by a riddle made for that purpoſe, their chief care is, that it ſhould not change into a ſmall worm; for this purpoſe they ſprinkle it with vinegar, and ſometimes with very cold water; they then bring them to a warm place, or elſe expoſe them to the ſun to dry; without this, theſe inſects would deſtroy themſelves, and if they were dryed too precipitately, they would loſe their beautiful colour. Sometimes they ſeparate theſe ſmall inſects from their veſicles or bladders with the ends of their fingers by a gentle preſſure, which they form into ſmall round cakes. The Dyers pay dearer for this dye when in lump than when it is in grain.

Bernard de Bernitz, from whoſe book I have taken this, adds, that the great marechal Konitſpoliki, and ſome other Poliſh noblemen, who had lands in the Ukrania, ſet this gathering of the coccus to the Jews at a conſiderable profit, and cauſed it to be gathered by their vaſſals; that the Turks and Arminians, who bought this drug of the Jews, uſed it for the dying of wool, ſilk, the manes and tails of their horſes; that the Turkiſh women made uſe of it to paint their fingers' ends of a beautiful carnation colour; and that formerly the Dutch uſed to buy the coccus at a high price, and mixed it with an equal quantity of cochineal; that with the dye of this inſect and chalk, a lacque for the painters might be made as fine as the Florence lacque; and that a beautiful red was prepared from it for the toilet of the ladies in France and Spain.

CHAP. IV.

OF THE RED OF MADDER.

THE root of madder is the only part of this plant which is uſed in dying. Of all the reds this is the moſt laſting, when it is put on a cloth or ſtuff that is thoroughly ſcoured, then prepared with the ſalts with which it is to be boiled two or three hours, without which, this red, ſo tenacious after the preparation of the ſubject, would ſcarcely reſiſt more the proofs of the reds than any other ingredients of the falſe dye. This is a proof that the pores of the fibres of the wool ought not only to be well ſcoured from the yolk or unctuous tranſpiration of the animal, which may have remained, notwithſtanding the ſcouring of the wool after the common manner with water and urine; but it is alſo neceſſary, that theſe ſame pores be plaiſtered inwardly with ſome of thoſe ſalts which are called hard, becauſe they do not calcine in the air, and cannot be diſſolved by rain water, or by the moiſture of the air in rainy weather. Such is, as has been ſaid before, the white crude tartar, the red and the cryſtal of tartar, of which, according to common cuſtom, about a fourth is put into the preparing liquor, with two-thirds or three-fourths of alum.

The beſt madder roots come generally from Zealand, where this plant is cultivated in the iſlands of Tergoés, Zerzée, Sommerdyke, and Thoolen. That from the firſt of theſe iſlands is eſteemed the beſt; the ſoil is clay, fat, and ſomewhat ſalt. The lands that are deemed the beſt for the cultivation of this plant are new lands, that only ſerved for paſture, which are always freſher and moiſter than others. The Zealanders are beholden to the refugees of Flanders for the cultivation and great commerce of this root.

It is known in trade and dying under the names of grape-madder, bunch madder, &c. It is however the ſame root; all the difference in regard to its quality is, that the one kind contains pith and root, and the other has the ſmall fibres from its principal root adhering to it.

Both are prepared by the ſame work, which I ſhall not relate the particulars of here, as it would only ſerve to lengthen this treatiſe to no purpoſe.

They chooſe the fineſt roots for the firſt ſort, drying them with care, grinding them and ſeparating the rind at the mill, and preſerving the middle of the root ground in hogſheads, where it remains for two or three years; for after this time, it is better for dying than it would have been coming from the mill; for if madder was not kept cloſe after this manner, the air would ſpoil it, and the colour would be leſs bright. It is at firſt yellow, but it reddens and grows brown by age; the beſt is of a ſaffron colour, in hard lumps, of a ſtrong ſmell, and yet not diſagreeable. It is alſo cultivated about Liſle in Flanders, and ſeveral other places of the kingdom, where it was found to grow ſpontaneouſly.

The madders which are made uſe of in the Levant and in India, for the dying of cottons, are ſomewhat different from the kinds uſed in Europe, it is named *chat* on the coaſt of Coromandel. This plant thus called, grows abundantly in the woods on the coaſt of Malabar, and this chat is the wild ſort. The cultivated comes from Vaſur and Tuccorin, and the moſt eſteemed of all is the chat of Perſia, named *dumas*.

They alſo gather on the coaſt of Coromandel the root of another plant called *ray de chaye*, or root of colour, and which was thought to be a kind of *rubia tinctorum*, but is the root of a kind of *gallium flore albo*, as it appeared by obſervations ſent from India in 1748. It has a long ſlender root, which dyes cotton of a tolerable handſome red, when it has received all the preparations previous to the dye.

At Kurder, in the neighbourhood of Smyrna, and in the countries of Akiſſar and of Yordas, they cultivate another kind of madder, which is called in the country *chioc-boya ekme hazala*. This of all the madders is the beſt for the red dye, by the proofs that have been made of it, and far more eſteemed in the Levant than the fineſt Zealand madder the Dutch bring there. This madder ſo much valued is called by the modern Greeks *lizari*, and by the Arabs *foiioy* *.

There is another kind of madder in Canada called *tyſſa-voyana*. It is a very ſmall root, which produces pretty near the ſame effect as our European madder.

The water of preparation for madder red is pretty near the ſame as for kermes, that is compoſed of alum and tartar. The Dyers do not agree as to the proportions; but the beſt appears to be four ounces of alum and one of red tartar to each pound of ſpun wool, and about one-twelfth part of ſour water, and let the wool boil in it for two hours. If it is ſpun wool, leave it for ſeven or eight days, that it may be well moiſtened by the diſſolution of theſe ſalts; and if it is cloth, finiſh it the fourth day.

To dye wool with madder, prepare a freſh liquor, and when the water is come to a heat to bear the hand, put in half a pound of the fineſt grape madder for each pound of wool; let it be well raked and mixed in the copper before the wool goes in, keep the wool in an hour, during which time it muſt not boil *. Shades from madder are obtained after the manner laid down for other colours, but theſe ſhades are little uſed, except in a mixture of ſeveral colours.

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* Theſe kinds of madders give brighter reds than the beſt grape madder of Zealand, for they are dyed in the air and not in a ſtove. The madder of Languedoc, even that of Poitou, ſucceeds as well as that of lizari, when it is dried without fire.

When ſeveral pieces of cloth are to be dyed at once in madder red, the operation is the ſame, only augmenting the ingredients in proportion; and let it be remarked that in ſmall operations the quantity of ingredients muſt be ſomewhat greater than in great, not only in madder red, but in all other colours.

Theſe reds are never ſo beautiful as thoſe of the kermes, and much leſs ſo than thoſe of the lacque or cochineal, but they coſt leſs, and are made uſe of for common ſtuffs whoſe low prices would not allow a dearer dye. Moſt of the reds for the army are of madder, ſaddened with archil or brazil, (though theſe drugs be of the ſafe dye) to make them finer, and more on the velvet, which perfection could not be procured to them even with cochineal, without conſiderably augmenting the price.

I have already ſaid that madder put on ſtuffs not being prepared to receive it by the alum and tartar-water, did in fact give its red colour, but that which it dyed was blotted and not laſting, it is therefore the ſalts that ſecure the dye; this is common to all other colours red or yellow, which cannot be made without a preparing liquor. Now the queſtion is, whether theſe act by taking off the remains of the oily and fat tranſpiration of the ſheep, or

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* If madder is boiled, its red becomes obſcure, and of a brick colour.

or whether that of the two ſalts, particularly that which even cannot be carried by luke-warm water, remains to catch, ſeize and cement the colouring atom, opened or dilated by the heat of water to receive it, and contracted by the cold to retain it.

To determine which, uſe any alkaline ſalts, ſuch as pot-aſh, the clarified lays of oak-aſhes, or any other pure lixivial ſalt inſtead of alum and tartar, put in a due proportion ſo as not to diſſolve the wool, and afterwards dip the ſtuff in madder liquor. This ſtuff will come out coloured, but will not laſt, even boiling water will carry off three-fourths of the colour. Now it cannot be ſaid that a fixed alkaline ſalt is unfit to extract from the pores of the wool the yolk or fat of the ſheep, ſince lixivial ſalts are uſed with ſucceſs in ſeveral caſes, to take the greaſe out of ſtuffs of what kind ſoever they be, which water alone could not take off. It is alſo well known, that with fats foreign to the ſtuff, and an alkaline ſalt, a kind of ſoap is formed which water eaſily carries off.

Again, take a piece of ſtuff dyed in madder red, according to the uſual method, boil it ſome time in a ſolution of fixt alkaline ſalts, a ſmall quantity will alſo deſtroy the colour, for the fixt alkali, attacking the ſmall atoms of the cryſtal of tartar or crude tartar, which lines the pores of the wool, forms a ſoluble tartar, which water diſſolves very eaſily, and conſequently the pores being opened in the hot water of the experiment, the colouring atom came out with the ſaline atom that ſheathed it.

This ſtuff being waſhed in water, the remaining red colour is diluted, and a colour half brown and half dirty remains. If, inſtead of an alkaline ſalt, ſoap is ſubſtituted, (which is an alkaline ſalt, mitigated by oil) and another piece of cloth dyed alſo in madder, be boiled for a few minutes, the red will become finer, becauſe the alkali which is in the ſoap being ſheathed with oil, it could not attack the vegetable acid, and the boiling only carried off the colouring parts ill ſtuck together, and their numbers diminiſhing, what remains muſt appear deeper or clearer.

I muſt alſo add, for further proof of the actual exiſtence of ſalts in the pores of a ſtuff prepared with alum and tartar, before dying it with madder, that more or leſs tartar gives an infinite variety of ſhades with this root only; for if the quantity of alum be diminiſhed, and that of the tartar augmented, a cinnamon will be had, and even if nothing but tartar alone be put into the liquor, the red is loſt, and a deep cinnamon or brown-root colour is obtained, though of a very good dye; for the crude tartar, which is an acid ſalt, has ſo much diſſolved the part which ſhould have produced the red colour, that there only remained a very ſmall quantity, with the ligneous fibres of the root, which, like all other common roots, does then yield but a brown colour, more or leſs deep according to the quantity uſed. I have already proved that the acid which brightens the red, diſſolves them if too much is uſed, and divides them into particles ſo extremely minute, that they are not perceptible.

If in the place of tartar, any ſalt which is eaſily diſſolved be put with the alum in the liquor, to prepare the ſtuff for the madder dye, ſuch as ſalt petre, the greater part of the madder red becomes uſeleſs, it diſappears, or does not ſtick on, and nothing is got but a very bright cinnamon, which will not ſufficiently ſtand the proof, becauſe the two ſalts uſed in the preparing liquor are not of the hardneſs of the tartar.

Volatile urinous alkalis which are obtained from certain plants, ſuch as the perilla, the archil of the Canaries, and other moſſes or lichens, deſtroy alſo the madder red, but at the ſame time communicate another to it, for on experiment, madder prepared after the manner of archil with fermented urine and quick lime, produced only nut colours, but which nevertheleſs are laſting; becauſe there entered into the liquor only the little portion of urinous volatile that moiſtened the madder which the boiling was ſufficient to evaporate, and beſides, the cloth was ſufficiently furniſhed with the ſalts of the liquor made as uſual, to retain the colouring parts of the dye.

When a pure red, that for cochineal an example, is laid upon a cloth firſt dyed in blue, and afterwards prepared with the liquor of tartar, and alum to receive and retain this red, a purple or violet is produced according to the quantity of blue or red. The red of madder has not this effect, for it is not a pure red like that of the cochineal, and as I ſaid above, it is altered by the brown ligneous fibres of its root, and makes on the blue a cheſnut colour, more or leſs deep according to the preceding intenſity of the blue firſt laid on. If this cheſnut colour is wanted to have purple caſt, a little cochineal muſt be added.

In order to avoid this brown of the root, the Dyers who make the beſt reds of madder take great heed to uſe the liquor of madder a little more than luke-warm; the madder tarniſhes conſiderably by the heat of the water, extracting the particles which dye brown, and unite themſelves with the red.

This inconveniency might be remedied, if at the time that the madder root is freſh a means could be found to ſeparate from the reſt of this root the red circle which is underneath its brown pelicle, and which ſurrounds the middle pith; but this work would augment its price, and even then it would not afford ſo good a red as cochineal. However, it might be attempted to dye cottons red, whoſe price might bear the expences of this preparation.

Madder being of all ingredients the cheapeſt of any that dye red and of the good dye, it is mixt with others to diminiſh the price. It is with madder and kermes that the baſtard ſcarlets of grain are dyed, otherwiſe called half-grain ſcarlets, and with madder and cochineal the half-common ſcarlets, and the half-crimſons are made.

To make the half-grain ſcarlet, the water of preparation, and all the reſt of the operation is to be performed after the ſame manner as ſcarlet made of the grain of kermes, or the common Venetian, only the ſecond liquor is compoſed of half kermes and half grape madder.

For the half-ſcarlet and flame-colour, the compoſition and preparation is as uſual, nothing but pure cochineal being put in, but in the reddening, half cochineal and half madder is uſed: here alſo the ſylveſtre may be made uſe of, for after having made the preparation with cochineal, for reddening, uſe half a pound of cochineal, a pound and a half of ſylveſtre, and one pound of madder inſtead of cochineal alone.

That the wool and ſtuffs may be dyed as equally as poſſible, it is neceſſary that the two kinds of cochineal be well rubbed or ſifted, as alſo the madder, with which they muſt be well incorporated before they are put into the liquor. This muſt be obſerved in all colours where ſeveral ingredients are mixt together. This half ſcarlet is finiſhed like the common ſcarlet, and it may be ſaddened after the ſame manner, either with boiling water or alum.

The half-crimſon is made like the common crimſon, only uſing half madder, and half cochineal, the cochineal ſylveſtre may be uſed here alſo, obſerving only to retrench half of the common cochineal, and to replace it with three times as much of the ſylveſtre. If a greater quantity of the ſylveſtre was uſed, and more of the other taken off, the colour would not be ſo fine. Various ſhades may be produced by augmenting or leſſening the madder or cochineal.

Purple with Madder without Blue.

I ſhall finiſh this chapter with an experiment which afforded a pretty fine purple without cochineal, or without the cloth being firſt dyed blue. I boiled a piece of cloth weighing half an ounce, with ten grains of Roman alum, and ſix grains of cryſtal of tartar; half an hour after, I took it out, wrung it, and let it cool; then added to the ſame liquor twenty-four grains of grape madder; after it had furniſhed its dye to this liquor, ſtill impregnated with ſalts, I dropt in twenty-four drops of a ſolution of biſmuth, made with equal parts of water and ſpirit of nitre, and then dipt my cloth again. Half an hour after, I took it out, wrung and waſhed it; it was almoſt as fine a crimſon as if it had been done with cochineal, it had even a ſufficient ground to have remained in that ſtate.

I dipt it again in the ſame liquor, and boiled it for a quarter of an hour; it came out a pretty bright purple; this purple, tried by the proof of alum, rouſes and embelliſhes itſelf, and by the proof of ſoap it remained of a much finer red than the common reds of madder.

If the cloth be kept for ſeveral days moiſtened in its liquor of tartar and alum, and afterwards dyed in freſh madder liquor, plain and without ſalts, according to the common method, till it has taken a bright cinnamon colour, and to this liquor be added the ſame ſolution of biſmuth, a cheſnut colour, and no purple will be obtained. This ſhows what exactneſs is required in deſcribing the proceſſes of dying, for want of which, all books hitherto publiſhed on this art have been uſeleſs, as they neglected to point out the neceſſary circumſtances for the ſucceſs of the deſired colour.

In this ſecond experiment, the cloth did at firſt take too much ſalts, they remained too long in it, and there was none in the liquor of the dye; for want of alum the purple did not appear, becauſe the white earth of this ſalt could not precipitate itſelf with the diſſolved parts of the biſmuth, which, as has been ſaid in the chapter of the kermes, carry with them the blue parts of the ſmalt, which is always found in the mine of biſmuth, and a portion of which very probably unites itſelf to this half metal during the melting. This mutual precipitation is performed in operation of dying, by the help of the aſtringent parts of the ligneous fibres of the madder root.

CHAP. XV.

OF YELLOW.

Hitherto ten ſorts of drugs have been named for dying yellow, but by the proofs that have been made it is certain there are but five that are ſufficiently laſting to be uſed in the good dye. Several more might be added to theſe five, as yellows are eaſily obtained. I ſhall therefore firſt ſpeak of theſe five, which are the weld or wold, ſavory, green wood, the yellow wood, and the fenugreek, becauſe theſe only are of the good dye. The three firſt are very common plants in Europe, the yellow wood comes from the Indies, and fenugreek is found every where. Weld is moſt commonly uſed, as it gives the brighteſt dye. The ſavory and the green wood are beſt for wools that are to be made greens, becauſe their natural colour borders a little on the green; the two others give ſhades of yellow ſomewhat different.

The yellows moſt known in the art of dying are the ſtraw yellow, the pale yellow, and the lemon yellow. The orange yellows commonly made are not ſimple colours, therefore I ſhall not ſpeak of them here.

For dying yellow, the common preparing water with tartar and alum is uſed for wool or ſtuffs, in the proportion of four ounces of alum for each pound of wool, or twenty-five pounds for the hundred, and one ounce of tartar, and the method of boiling is the ſame as before. For welding, after the wool or ſtuff is boiled, put five or ſix pounds of weld in a freſh liquor for each pound of ſtuff; let the weld be incloſed in a linen bag, that it may not mix with the ſtuff, and that the bag may not riſe to the top of the copper, it muſt be kept down with a heavy croſs of wood. Others boil the weld till it has furniſhed all its dye, and ſinks itſelf to the bottom of the copper, at which time they place on it a croſs or iron circle fitted with a net of cords. Others take it out with a rake when it is ſufficiently boiled: ſometimes yellow wood and other ingredients are mixed with the weld, according to the ſhade required, by altering the quantities and the proportions of the ſalts in the preparation, and the time of boiling. I know by experience, that theſe ſhades may be obtained *ad infinitum*. This proof I have had in the eſſays I made with the flower of the virga, a very great acquiſition in the art of dying, if this plant was improved, which may be eaſily done, ſince it ſhoots a great many ſtems, and whoſe ſmall ones may be eaſily tranſplanted, and produce quantities in the courſe of one year.

Light ſhades of yellow are obtained in the ſame manner as all others ſpoken of, only the preparing liquor for theſe light yellows muſt be weaker. I recommend twelve pounds and a half of alum for each hundred pounds of wool, and the tartar in proportion; but theſe light ſhades do not reſiſt the proofs as deeper ſhades do, made with the full proportion of tartar.

Some Dyers endeavouring to help this, leave the wool and ſtuffs for a longer time in the dye, becauſe they take it ſlower in proportion to the weakneſs of the liquor; but if they put at the ſame time in the colouring liquor, wools whoſe preparation ſhall have been different, they ſhall take at the ſame time different ſhades. Theſe liquors more or leſs ſtrong are called half-preparing liquors, or quarter-preparing liquors, and they make great uſe of them in light ſhades of wool dyed in the fleece, that is, before being ſpun, and which are intended for the manufacturing of cloths and other mixed ſtuffs; becauſe the more alum there is in the liquor of the wool, the more it is harſh and difficult to ſpin, and it muſt ſpin thicker, and conſequently the ſtuff is coarſer. This obſervation is not of great conſequence for ſpun wool which is intended for tapeſtry or for ſtuffs. I only mention it to ſhow that the quantity of ingredients may be ſometimes varied without danger.

The yellow wood is uſed in chips, or in coarſe ſhavings; by this means it is more divided, and yields its dye the better, and a leſs quantity will do; which way ſoever it is uſed, it is put into a bag, that it may not mix with the wool or ſtuffs. The ſame precaution is neceſſary for the ſavory and green wood, when they are mixed with the weld to change its ſhade.

I refer to the leſſer dye the five other ingredients hitherto known which dye yellow, and ſhall only obſerve here in regard to the good dye, that the root of the dock, the bark of the aſh-tree, particularly that which is raiſed after the firſt ſap, the leaves of almond, peach and pear-trees; in ſhort, all leaves, barks, and roots, which by chewing ſhow ſome little aſtriction, give yellows of the good dye more or leſs fine, according to the time they are boiled, and in proportion to the tartar and alum uſed in the liquor: a proper quantity of alum brings theſe yellows to the beautiful yellow of the weld. If the tartar is in greater quantity, theſe yellows will border on the orange; and laſtly, if theſe ingredients are too much boiled, let them be roots, barks, or leaves, the yellow obſcures itſelf, and takes brown ſhades.

Although ſome Dyers uſe turmerac in the good dye, which gives an orange yellow, this practice is to be condemned, for it is a colour that ſoon paſſes in the air, unleſs it be ſecured by ſea-ſalt, which ſome Dyers do, who take care to keep this impoſition to themſelves. Thoſe who make uſe of it in common ſcarlets, to ſpare cochineal, and to give to their ſtuff a red bordering on the orange, are blameable, for the ſcarlets that have been dyed after this manner loſe in a ſhort time that bright orange, as I have already ſaid, they brown conſiderably in the air. Yet theſe falſifications are obliged to be in ſome meaſure tolerated; for at this time that bright orange being in faſhion, it would be impoſſible to give it to ſcarlet, without putting a larger doſe of compoſition, whoſe acids would greatly hurt the cloth. The fuſtic wood is now preferred in ſcarlet.

CHAP. XVI.

OF BROWN.

BROWN is the fourth of the primary colours. It is placed in this rank, becauſe it enters in the compoſition of a great number of colours. The working it is different from others, for commonly no preparation is given to wool to be dyed brown, and, like the blue, it is only dipped in hot water.

The rinds and roots of walnut, the rind of the alder, ſantal, ſumach, roudoul or ſovic, ſoot, &c. are uſed in this dye.

The rind of the walnut is the green part that covers the nut; they are gathered when the nuts are entirely ripe, then filled into great caſks and moiſtened with water; they are thus preſerved until the enſuing year, and longer if required.

The ſantal or ſaunders is a hard wood brought from the Indies; it is commonly uſed ground to a very fine powder, it is preſerved for ſome time in this ſtate in bags, to excite (as is imagined) a ſlight fermentation, which they pretend makes it the better for uſe, but I could find no difference.

This wood is moſt commonly ground with a third part of cariatour wood, which ſoftens it according to thoſe who ſell it. It is greatly inferior to walnut rinds, for it hurts the wool by hardening it conſiderably if uſed in large quantities, therefore it is better not to uſe it for fine wools and ſtuffs, or at leaſt to draw but the lighteſt ſhades, for then its effect will be of leſs conſequence. It is generally mixed with galls, alder, bark, and ſumach; it is only by this means that it gives its colour when uſed alone, and unmixed with the cariatour wood. It yields but very little with the liquor of alum and tartar unleſs it be raſped. Notwithſtanding this defect, it is tolerated in the good dye, on account of the ſolidity of its colour, which naturally is a yellow-red-brown: it browns and grows deep in the air, it lightens with ſoap, but looſes leſs by the proof of alum, and ſtill leſs by that of tartar.

Of all the ingredients uſed for the brown dye, the walnut rind is the beſt; its ſhades are finer, its colour is laſting, it ſoftens the wool, renders it of a better quality, and eaſier to work. To make uſe of this rind, a copper is half filled, and when it begins to grow luke-warm, the rind is added in proportion to the quantities of ſtuffs to be dyed and the colour intended. The copper is then made to boil, and when it has boiled a quarter of an hour, the ſtuffs, which were before dipped in warm water, are put in. They are to be ſtirred and turned until they acquire the deſired colour. If it is ſpun wool, and that the ſhades required are to be matched with great exactneſs, a ſmall quantity of rind is to be put in firſt, and the lighteſt are firſt made; more rind is then put in, and then the deepeſt are made: but to work with ſtuffs, the deepeſt are generally made firſt, and as the colour of the liquor diminiſhes, the lighteſt are dipped; they are aired as uſual to cool them, dried, and dreſſed.

Next to the walnut rind is the root; it gives a great number of ſhades and pretty near the ſame; thus they may be ſubſtituted the one for the other,

according

according to the facility of obtaining them, but there is a difference in the manner of uſing the root. A copper is filled three quarters full of river water; the quantity of root that is thought convenient is cut into ſmall pieces, and added in proportion to the quantity of wool to be dyed and the ſhade required.

When the liquor is hot, ſo as not to bear the hand, the ſtuffs are put in and turned, until they have the deſired ſhade, carefully obſerving to air them from time to time, and to paſs them between the hands by the liſts, to make the ſmall pieces of roots that ſtick fall off to prevent their blotting; but this may be remedied by incloſing the cut root in a bag, as has been ſaid of the yellow root. The ſtuffs that are to be of lighter ſhades are then to be dipped, and to be thus continued until the root gives no more dye. If it is ſpun wool, the lighteſt are to be made firſt to match them the better, as I have already ſaid in ſpeaking of other colours; but above all, care muſt be taken not to boil the liquor at firſt, for then this root would give all its colour to the firſt piece of ſtuff, and there would not remain ſufficient for the reſt.

The method of dying wool with roots is not very eaſy, for if great care is not taken to bring the dye to a proper degree of heat, and to ſtir the wool and ſtuffs ſo that they may be equally ſoaked in the copper, they run the hazard of being made too deep or of being blotted, which cannot be remedied but by giving them a cheſnut, prune, or coffee colour, as I ſhall ſhow when I treat of the colours and ſhades ariſing from the mixture of black and brown.

To avoid this inconvenience, the ſtuffs muſt be continually turned round the wynch, and dipped piece after piece, and great care muſt be taken not to boil the roots too much, but always to leave ſome dying ſubſtance in them. When the wool or ſtuffs are dyed after this method, they are aired, waſhed, and dried.

The method of treating the alder bark differs not from that of the walnut-root before deſcribed, except that there is leſs danger in boiling it at the beginning, as it gives leſs ground of colour to the ſtuff. It is commonly uſed for thread, and for colours that are to be ſaddened with green copperas; it has however a good effect on wool for colours that are not very deep, and it perfectly reſiſts the action of the air and ſun.

The ſumach is pretty near the ſame; it is uſed after the ſame manner as the green ſhells or inward coats of walnuts; it ſtill gives leſs ground of colour, and borders ſomewhat on the green; it is often ſubſtituted for galls in colours that are to be ſaddened, and it anſwers perfectly well, but muſt be uſed in larger quantities.

Theſe different matters are often mixed together, and as they are equally good, and produce nearly the ſame effect, they readily afford a variety of ſhades; and yet there is nothing but practice can teach this variety of brown ſhades, for they entirely depend on the eye of the Dyer.

To uſe theſe ingredients mixt, and ground ſaunders together, put four pounds of this laſt into a copper, half a pound of powdered galls, twelve pounds of elder bark, and ten pound of ſumach; this quantity will dye twenty-five or twenty-ſeven ells of cloth; the whole is boiled, and having ſlackened the boil by means of a little cold water, the cloth is put in, turned, and well ſtirred for two hours; after which it is taken out, aired and waſhed; other ſtuffs that are to be of a lighter ſhade are then put in, and thus continued as long as the liquor affords any colour.

The quantity of theſe ingredients is augmented or diminiſhed in propoition to the height of the ſhade, and the ſtuffs or wool are boiled more or leſs accordingly. I have already obſerved that by this means only the colour can be extracted from the ſaunders.

I have here treated of the ſaunders and the manner of uſing it, although it ſhould have been claſſed with the leſſer dyes, as this woad ought only to be uſed for ſtuffs of low prices, becauſe of the defects before ſpoken of; yet as it is worked almoſt after the ſame manner as the other ingredients for dying brown, and in ſeveral places is even tolerated in the good dye, as it reſiſts the ſun and air as well as the others, I thought it would not be improper here to give the method of working it; for the ſame reaſon I ſhall now deſcribe the method of dying with ſoot, though permitted only in the leſſer dye, having leſs ſolidity than the reſt, beſides hardening the wool, and giving a diſagreeable ſmell to the ſtuffs.

The ſoot * is commonly put into the copper the ſame time as the water, and the whole is well boiled together; the ſtuff is then dipt in, which is to boil more or leſs, according to the ſhade required; after which it is taken out and aired, and thoſe put in which are to be lighter; they are then to be well waſhed and dried, but it is better to boil the ſoot in the water for two hours then let it ſettle, and empty the liquor into another copper, without mixing the ſoot; the wool and ſtuffs are put into this liquor, and are leſs hardened and dried than when they have been mixt with the ſoot itſelf, but the colour is not ſolid, and it is better not to make uſe of it for dying ſtuffs that bear a price, and

more

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* Wood ſoot.

more ſo as all its ſhades may be had by the foregoing ingredients, which are better, more laſting, and alſo ſoften the wool.

The Dyers of the leſſer dye uſually employ th rinds of the nut and the root of the walnut-tre for their brown colours; the working of theſe tw ingredients being common to Dyers of the greate and leſſer dye; but there are places where it is difficult to obtain them, and then the ſaunders an even ſoot are obliged to be uſed in their ſtead.

What I have hitherto ſaid to account for th ſolidity of the colours of the good dye, may ſee not to agree with brown colours ſpoken of in th chapter, ſince theſe are firmly applied on the wo without any preparation to receive them by t liquor of alum and tartar, and conſequently without firſt introducing into the pores of the fibres ſalt capable of hardening itſelf in the cold, and cement the atoms that colour the brown; but if a chymical analyſis the green ſhell of walnuts, t root of the walnut-tree, the rind of alder, ſhou be proved to contain, beſides their aſtringent pr perties, a vitriolated tartar, which is a ſalt th does not calcine in the ſun, and that is only d ſolved by boiling water; this I ſay will convi that theſe ingredients are ſufficient of themſelves produce on the ſtuffs, without any foreign he the ſame effect as the other drugs, whoſe colo are not ſet in with ſolidity, but by the help o ſalt capable of cementing the colouring atoms.

The ſoot does not give ſo laſting a brown, cauſe it only contains a volatile and an earthy eaſily diſſolved, and in fact the ſoot being compoſed of the lighteſt and moſt volatile part combuſtible bodies, which have ſerved as food the fire, it could not raiſe tartar of vitriol al with it, which is a ſalt that does not riſe by heat, and which is alſo ſeldom found in the wood which we commonly burn in our chimnies.

As I am not willing to omit any thing within the limits of my knowledge, on the article of woollen dying, I ſhall give two or three hints on the acid of vitriol.

If you would have a beautiful claret on wool, ſtuffs, or cloth, boil in a copper of a good ſize, redwood or ſaunders in proportion to the ſhade you want, and two pounds of logwood, for forty pounds of wool previouſly ſcoured. When the ingredients have boiled half an hour, put a pint of oil of vitriol into a pail of cold water, and add it to the liquor, when the wool muſt be put in, and gently boiled for two or three hours. It it then to be taken up on a ſcray, that is, ſet acroſs the copper to drain, and five or ſix pails of water poured over it. The copper muſt be then run down and filled as before with fair water, and when it is hot, ten pounds of copperas and four ounces of pearl-aſhes muſt be added, and the wool returned and well worked with a long pole to make it even.

The aſhes (which are a fixed alkali) act upon the logwood, and give it a fine luſtre at the ſame time. It weakens the acid of the vitriol, and makes way for the copperas to do its part, which would otherwiſe be kept at a diſtance; the vitriol does not obſtruct the cloth in the fulling-mill, for the vitriol, which ſome ſuppoſe to be a great enemy in the mill, is diveſted of its acid by the ſtrong alkali contained in the chamberley in ſcouring, and the colour remains perfectly vivid. If for forty pounds of wool, &c. ten pounds of nut-galls were bruiſed and boiled with the above ingredients, the acid therein contained would produce as brilliant a colour, and, if poſſible, more holding than the former; but if galls are uſed, the ſame liquor will do the ſame buſineſs when the copperas is added without aſhes as a freſh water would when vitriol is uſed. If forty pounds of cloth, ſtuff, or worſted were boiled in a ſufficient quantity of redwood or ſaunders, and one pint of prepared aquafortis be added to the liquor after the goods have boiled an hour and a half, and then turned well for half an hour, the colour will be vivid and fine; the copper muſt be well cooled when the ſpirits are put in.

When cloth or ſtuffs are dyed claret with oil of vitriol, great care muſt be taken to turn them continually over the wench, and particularly in taking out, obſerve the inſtant the laſt end comes up to take off into a large tub of cold water, that all parts may cool alike, or the colour will be very uneven, as the vitriol when hot will not bear the air.

Oil of vitriol is ſo uſeful a thing in dying, that any colour, ſave woaded blue or green, may, by the help of its acid, be brought to a fine claret, black not excepted.

CHAP. XVII.

OF BLACK.

BLACK is the fifth of the primary colours. To dye the beſt and the moſt lively ſhade, a veſſe ſufficiently large muſt be filled with ſoft water, and for every hundred weight of cloth, thirty pounds o logwood in chips muſt be put in, with half a pai of elder bark and ſix pounds of ſumach; boil theſe ingredients together half an hour, when the cloth may be entered (the copper being firſt cooled by the addition of cold water) and boiled an hour and a half, being inſtantly turned on the wynch to prevent an unevenneſs of dye. This operation being ended, which is called a preparation or ſtuffing the blacks, I ſhall proceed to the finiſhing.

A ſmall tub is to be placed at the ſide of the copper, out of which it muſt be filled with hot liquor, in which put ten or fourteen pounds of copperas to diſſolve; the cloth is then kept turning, whilſt a man with a piggin is lading the copperas water into the copper; the cloth is turned here at a boiling heat one hour, then taken out and cooled well in all parts alike; when thoroughly cold, return it into the copper, with two handfuls of copperas, and boil it gently as before for two hours, then cool it again.

Whilſt the ſecond cooling is carrying on, ſix pounds of logwood, ten pounds of bark, and two pounds of argil, with ten pounds of ſoda or common aſhes, and three pounds of copperas, muſt be added to the liquor; theſe ingredients muſt be made to boil one hour, when the goods muſt be turned and worked one hour. Keep the wynch continually turning, always obſerving that the ſmall portion of air which the goods receive by turning on the wynch, contributes much to the beauty of the colour. Some Dyers inſtead of aſhes uſe chamberley, but this is a bad cuſtom. If they would become good black Dyers, they muſt abandon their old practice, and by mixing their natural genius with reaſon and good ſenſe, they will ſoon find by experience, that the acid of the argil acts only on the vitriolic acid of the copperas, and prevents a brown or ruſty hue that will unavoidably proceed from the logwood; the alkaline power of the aſhes at the ſame time forces it to aſſume it natural violet colour; that if too great a quantity of logwood is not uſed, (which would certainly prejudice the colour) and this rule carefully obſerved, the black would reſemble a raven's feather; they muſt be well waſhed at the fulling-mill.

I ſhall not entertain the reader with a tedious recital of the manner of treating thoſe goods whoſe ſuperior quality renders it needful that they ſhould previouſly be dyed blue. It is ſufficient to know, that they muſt have a leſs proportion of ingredients, though the operation is the ſame as that of the common black.

When fine cloth is to be dyed black, great care muſt be taken not to let it hang on the wynch one minute; it muſt be thrown off that inſtant the laſt comes up; otherwiſe its own weight when wet and hot would fill it with wrinkles that would never remove. The ſame caution muſt be taken when the cloth is on the floor, to draw it between two men over a long ſtick by the liſts, each taking hold of one end with their left hand, to be continued till cold before it be returned.

Remarks on the Black Dye.

The moſt eſſential thing to be remarked is, that it prejudices and weakens the goods; for this reaſon thoſe that are dyed black are ſooneſt worn out; they are however in all other reſpects equal to thoſe that are dyed other colours. This defect is chiefly to be attributed to the vitriolic acid of the copperas, which is only imperfectly ſaturated by the iron; as iron united to any other acid, and even to vegetable acids, is capable of producing black with aſtringent vegetables. There is great cauſe to think that by ſubſtituting other combinations of this metal for the copperas, this inconvenience might be remedied.

Theſe are certainly good and uſeful eſſays to attempt. It is not without cauſe that the blacks are directed to be aired between the dippings, as it infinitely contributes to the beauty of the dye; for it is certain that this dye is different from moſt others which loſe of their colour in drying; this, on the contrary, acquires a great deal; it is univerſally known, that good writing ink does not appear any thing near ſo black when freſh and recently uſed, as when dry, and that even it grows more black during a certain ſpace of time. The ſame happens to the black dye. The cloth is in ſome meaſure of a grey blackiſh colour immediately after the firſt dip; it only acquires the beautiful black on being expoſed to the air; this is not the only example of the influence of the air on colours; the blue vat exhibits ſomething like it.

CHAP. XVIII.

OF THE MIXTURE OF BLUE AND RED.

IN ſpeaking of the red I obſerved that there were four different kinds in the good dye. We ſhall now explain the effect of theſe different reds placed on a ſtuff that has been previouſly dyed blue. If a blue ſtuff is boiled in alum and tartar, (after the manner and proportion taught in the article of red, and which is afterwards to be dyed with kermes) the following colours will reſult, viz. The king's colour, the prince's colour, the panſy, the violet, the purple, and ſeveral other like colours; but the kermes is ſeldom uſed for theſe colours, on account of its high price, and the quantity which would be required, but more ſo, becauſe cochineal yields a finer colour for this purpoſe, and with greater eaſe. I have already obſerved that kermes is ſeldom uſed, though there are ſeveral compound colours in which it produces a very good effect, as will be more particularly deſcribed.

When the kermes is uſed to lay a red on blue, it is indifferent what ground of blue is firſt given, or whether it be given before or after the ſtuff is dyed red, becauſe the colour of the kermes is too ſolid to be changed by the lime of the woad vat, (unleſs the vat be overloaded) or by the pearl-aſhes in the indigo. Thus if the woad vat is not too old, it may be begun by either of theſe two colours at pleaſure, or by that which is moſt convenient to match the ſhade. Although I named but a ſmall number of colours, a great many may be drawn from theſe two principal ones, according as the one or the other may be more predominant.

The mixture of blue with fire-colour ſcarlet is never uſed in any of their ſhades. To convince myſelf by experience, I took a piece of cloth dyed in ſcarlet, and dipt it in the blue vat, and I dyed a ſecond piece according to the method of dying ſcarlet, having previouſly dyed it blue. The one and the other ſucceeded very badly, and made a kind of dull ſpotted violet, ſo it appeared that the two colours did not unite, but that they were laid each on different parts of the wool. This no doubt is cauſed by the acids which enter the compoſition of the ſcarlet. But without entering here upon the phyſical reaſon of this operation, which might occaſion too long a diſſertation, and tedious repetition of what I have already ſaid, the fact appears ſufficient here: it proves that no beautiful colour can be had from the mixture of blue and ſcarlet; it muſt be crimſon.

From the mixture of blue and crimſon, the columbine, the purple, the amaranth, the panſy, and the violet are formed; theſe colours have alſo a great number of ſhades which depend upon the ſhades of the other colour, from whence they are derived.

I have ſaid ſo much on the primary colours, that no difficulty can remain in the execution of the compound colours.

Stuffs or ſpun wool are firſt made of one colour, and then dyed of the other, preciſely as if it was white; but it muſt be obſerved in this caſe, that the ſtuff be firſt dyed blue before it is made into crimſon, for the reaſon before given, that the alkali of the one or other vat greatly obſcures the brightneſs of the red of the cochineal.

To make violets, purples, and other like ſhades, what I have already ſaid on crimſon is to be followed, becauſe theſe colours will have neither brightneſs nor luſtre, but by following the precautions neceſſary for fine crimſons.

From blue, and the red of madder, proceeds alſo the king's colour, the prince's colour, (but infinitely leſs beautiful than when the kermes is made uſe of; for the red of the madder is always obſcured by the brown of its ligneous parts) the minime, the tan-colour, the amaranth, the dry roſe, always leſs bright than when the kermes is made uſe of. Nevertheleſs it is ſometimes mixed with madder, as I have already ſaid, to make half-grained ſcarlets, and the colours which proceed from it are always finer than when madder alone is uſed on a ſtuff dyed blue; madder is alſo mixed with cochineal, as in the half crimſons, and a great number of very fine ſhades are drawn from them,

which

which cannot have particular names, but which border on thoſe I have juſt mentioned. Some o theſe may be made as fine as if dearer ingredients were made uſe of. It is the buſineſs and profit o the Dyer not to uſe the deareſt, when the ſame effects may be produced by the cheapeſt ingredients. It is impoſſible for me to give any inſtructions on this article, ſince uſe alone can teach it. The old liquor of madder and cochineal is often uſed, whoſe colours have not been entirely extracted, which makes a conſiderable ſaving, and the colour is not leſs good. I can ſay nothing poſitive on this, ſince the effect which will reſult from it depends on what colour may remain in the liquor, and on the ſhade intended.

CHAP. XIX.

OF THE MIXTURE OF BLUE AND YELLOW.

FROM the mixture of blue and yellow but one colour is produced, which is green; but there are a variety of ſhades; the principal ones are, the yellow green, the light green, the gay green, the graſs green, the laurel green, the molequin green, the deep green, the ſea green, the celadon green, the parrot green, the cabbage green, and I ſhall add, the duck-wing green, and the celadon green without blue. All theſe ſhades, and the intermediate ones, are made after the ſame manner and with the ſame eaſe. The ſtuff or wool dyed blue, light or dark, is boiled in alum and tartar, as is uſually done to make a white ſtuff yellow, and then with weld, ſavory, or greening wood. All theſe ingredients are equally good as to ſolidity, but as their yellows differ a little, ſo do the greens that ariſe from their mixture. The weld and the ſavory are the two plants that afford the fineſt greens.

To make the green ſhades which border on the yellow, the ſtuff muſt be of a very light blue, and boiled with the common quantity of tartar and alum to receive the yellow; for without theſe ſalts it would not be laſting, (but for a parrot or cabbage green the blue muſt be very deep) and as it is only to have a light yellow, the ſtuffs muſt have but a half preparation; I have already mentioned this; ſometimes even a quarter of the water for the common preparation is ſufficient.

When the workmen make theſe colours, they often uſe the ſalts without weighing them, and gueſs at the quantity which they think neceſſary for the ſhade intended; a long practice may in ſome meaſure make them pretty exact, but it would be ſtill better if they did not truſt to it.

I know by repeated experiments that theſe green-blue ſhades are as well made by giving the ſtuff the common preparation. The yellow which is afterwards applied to it is the more laſting, but on this occaſion leſs weld is to be put into the liquor of the dye, or any other colouring matter, and the ſtuff muſt remain leſs time in the liquor, notwithſtanding two reaſons induced to the contrary; the firſt and moſt intereſting to the Dyer is, that they would conſume a greater quantity of drugs than is neceſſary; and the ſecond, that the leſs alum uſed in the preparation, the more the ſoftneſs and the quality of the wool is preſerved, and the leſs the firſt dye of blue is damaged; for the alum always greys the blues a little. Thus it is better to leave the Dyer to his cuſtom of regulating the ſtrength of

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his preparation to the neceſſary pitch to give theſe colours.

I have ſaid that to dye green it was neceſſary that the wool ſhould be previouſly blue; becauſe I think that the two colours laid on in this order hold better, and that the colour would not be ſo good if otherwiſe done. Of this I aſſure myſelf by making the greens, of which I have ſpoken, with the five colouring matters already known, which make a yellow of the good dye; I have tried a yellow of the ſame materials, the contrary, having dipped five yellow pieces in the woad vat, and have had as fine greens as the firſt. I expoſed both to the ſummer's ſun, and they have reſiſted ſufficiently to be eſteemed of the good dye; but thoſe which had received the blue before the yellow loſt the leaſt, ſo that in particular circumſtances the Dyer muſt be allowed to begin firſt with yellow. But greens which have the blue colour laſt, will ſully the linen more than the others; for if the blue has been firſt dyed, all that could be taken off was done by the alum liquor, which happens on the contrary when the blue was put on laſt; the only remedy for this is, to ſcour the green well after it comes out of the copper.

Cloth dyed king's blue, and greened with the flower of the *virga aurea Canadienſis*, make a very fine green, provided it has been boiled in a liquor with three times the weight of alum to one of white tartar; the green is not inferior to that made of weld.

I have alſo greened blues with aſh-bark powdered; they are of a very good dye, but not of a fine colour, and only fit for liveries The leaves of almond, peach and pear trees, &c. give yellows, which ſerve to make green ſhades, that are rather difficult to hit on at firſt.

A ſtuff dyed in the king's blue, well ſcoured, then boiled with four parts of alum, and one of tartar, takes a fine deep green of the ſhade of a duck's wing; but it muſt be boiled for two hours in a liquor, with a ſufficient quantity of the root of ſharp pointed dock groſsly bruiſed.

This root, which grows in every hedge and field, is a good acquiſition to the art of dying; for with it, and without any other addition but the preparing liquor for the ſtuffs, it produces an infinity of ſhades, from the ſtraw colour to a pretty fine olive; only putting more or leſs to the liquor, and boiling it from half an hour to three hours. Theſe ſhades ſtand all manner of proof. I ſtrongly recommend the cultivation of this dock in damp places, for its uſe in dying.

The celadon green (a particular colour) is much admired by the inhabitants of the Mediterranean, and may in ſtrict buſineſs be made in the good dye, by giving a blue ground to the ſtuff. But this ſhade of blue muſt be ſo weak, that it is only a milk and water colour, which is very difficult to give ſmooth and equal. When this ſhade has been happily hit, it is eaſier to give the yellow dye that ſuits it, with the *virga aurea* than with the weld. The *virga aurea* is not known to the Dyers of Languedoc, who make moſt of theſe kind of colours, and as the neceſſary blue ſhades are difficult to dye, they are ſometimes permitted to dye celadons with verdigriſe, although this colour be in the rank of the leſſer dye.

The Dutch make this colour perfectly, and render it more laſting than it commonly is with the verdigriſe Here follows their method.

Two coppers are ſet a little diſtance the one from the other. In the firſt is put for two pieces of cloth of forty-five or fifty ells long, eight or ten pounds of white ſoap cut ſmall and perfectly melted. When the liquor is ready to boil, the cloths are dipt in, and boil for half an hour. Another liquor is prepared in the next copper, and when it is ſcalding hot a cloth bag is put in containing eight or ten pounds of cyprus or blue vitriol, and ten or twelve pounds of lime, both powdered and well mixt; this mixture muſt be as equal as poſſible. The bag is moved about in the hot water, but not boiling, till all the blue vitriol is diſſolved in the liquor; then a wynch is put up, ſurrounded by a clean linen cloth, and well faſtened on; one end of the two cloths is put on the wynch, which is turned ſwiftly that the cloths may quickly paſs through the ſoap liquor to that of the vitriol; then the wynch is worked more gently, that the cloth may have time to charge itſelf with the parts of copper, which the lime has ſcattered in the liquor, by ſeparating and precipitating them from the vitriol which contained them. The cloths are left in this liquor, which muſt not boil until they have taken the ſhade of the celadon that was wanted; then they are taken out and well aired: they muſt be entirely cold before they are waſhed, and muſt touch no wood before they are, for the wood ſpots them; for this reaſon the wynch and the horſe are ſurrounded with cloth.

CHAP. XX.

OF THE MIXTURE OF BLUE AND BROWN.

LITTLE uſe is made of the ſhade which ariſes from the mixture of blue and brown: theſe are greeniſh greys, or a kind of olives, which are only fit to match ſhades for tapeſtries; theſe colours are eaſily made when wanted, and it is equal to begin by the blue or the brown colour to the ſpun wool; but care muſt be taken that it be well ſcoured, as is done for the blue and the compound colours which are finiſhed by dipping them in the vat. Any ſubſtance that dyes brown may be equally made uſe of for theſe colours, and ſome give the ſhade required better than others.

CHAP. XXI.

OF THE MIXTURE OF BLUE AND BLACK.

NO particular ſhade ariſes from this mixture, except by the mixture of blue and grey, (which are ſhades of the black). In this caſe the blue muſt not be very deep, and is afterwards worked the ſame as the black, excepting that the colour not being ſo dark leſs copperas enters in; but I repeat again that this colour ought only to be eſteemed a ſhade of the black Thus it may be ſaid that no ſhades are made from blue and black uſed by themſelves, and very few from blue and brown.

CHAP. XXII.

OF THE MIXTURE OF RED AND YELLOW.

FROM ſcarlet of grain or kermes and the yellow are formed the aurora, the marigold, and the orange. The wool is firſt boiled in alum and tartar, and dyed in one of theſe colours, and then dipped in the ſecond, or by mixing in the ſame liquor the kermes, the weld, the ſavory, &c. and ſo dying it at once. Yet it is eaſier to attain the exact ſhades by dying it at twice; for this reaſon, the wool or the ſtuff may be alternately paſſed in the one or other liquor, till it be preciſely of the deſired colour.

The lobſter and pomegranate colours are done exactly as ſcarlet is, that is, boiled with cream of tartar, cochineal, and the compoſition, after which they are taken out, aired, and waſhed. For the finiſhing, a freſh liquor is prepared as for the ſcarlet, but without cochineal; in its ſtead, a little yellow wood ground is ſubſtituted; this depends on the colour the ſtuff is intended to be of. The more it borders on the orange, the more yellow wood is added, diminiſhing the quantity of the cochineal.

I endeavoured to make this colour after three different methods, and ſucceeded in all; the firſt is that which I have deſcribed; the ſecond is by putting fuſtic inſtead of yellow wood, and this ſaves a great deal of cochineal, and the ſhade of the fuſtic is a great deal more on the orange than the yellow wood, but theſe ingredients are not laſting, and ought not to be uſed but in the leſſer dye. The method is with cochineal alone, by augmenting the quantity of the compoſition, which rouſes the cochineal, and turns it to orange as much as is deſired; but this is attended with very great inconvenience. 1ſt, The colour becomes very expenſive, becauſe it requires more cochineal than common ſcarlet, as the great quantity of the compoſition, which is an acid, makes it loſe part of its ground. 2d, For the ſame reaſon the colour always looks ſtarved, it appears as if the cochineal had been ſpared, the compoſition having diſſolved part of it. 3d, This large quantity of compoſition hardens the wool, and makes it more liable to be ſpotted by dirt and ſharp liquor, and conſequently this method is the worſt. I mentioned that the inconveniency of the ſecond was uſing the fuſtic, which is a wood forbid in the good dye; conſequently the firſt ought to have the preference, if it give the lobſter colour as bright as the ſecond. But this colour made by the yellow wood has not all the ſolidity that might be deſired, as I have tried by expoſing it to the ſun; this at firſt appears extraordinary, ſince the ingredients uſed have all the ſolidity poſſible. But the reaſon why they are not ſo good in the preſent caſe is, that the cochineal uſed in the ſcarlet compoſition and the cream of tartar are too ſolid; thus the lobſter colour loſes nothing in the air. But the caſe is otherwiſe with the yellow wood, though it be very laſting on the wool boiled in alum and tartar, eſpecially when a little alum is added to the liquor of its dye; it is not the ſame as when the wool or ſtuff has received the water for the ſcarlet preparation in which no alum can enter, and conſequently when theſe ſort of colours are expoſed to the air, they ſadden in a ſhort time, that is, they loſe part of their orange colour, produced by the mixture of the yellow with the red, and the effect of the air upon this colour is the ſame, though it appears different from that on all others, &c. that it commonly turns them pale; yet this one darkens and browns them by taking away part of its bright orange. For it is demonſtrated by ſeveral chymical experiments, that there is a vitriolic acid in the air like unto that which may be extracted from alum. Now if a ſtuff dyed lobſter colour was to be paſſed through a light ſolution of alum, the acid of the ſalt would immediately ſadden it, and the red of the cochineal would eclipſe the orange dye; the ſame thing muſt then happen when ſuch a colour is expoſed to the air, which is impregnated with the ſame acid.

Very few ſhades are made from the crimſon and yellow, becauſe of the price of the firſt, and that pretty near the ſame ſhades are made with madder and kermes, yellow and half ſcarlet of grain, as well as from the yellow and half crimſon. It is with theſe different mixtures, that marigold, orange, gold yellow, and other like ſhades are made, which are ſimply produced by the mixture of the yellow and red, and ſometimes by yellow alone.

CHAP. XXIII.

OF THE MIXTURE OF RED AND BROWN.

THE reds of the kermes and cochineal are not uſed in this mixture, for madder has as good an effect on thoſe which cannot become bright, becauſe of the dark obſcure colour of the brown, but after they are maddered, they are dipt in the old liquors of cochinal or kermes; yet a liquor in thoſe ingredients is ſeldom purpoſely prepared, being too dear for ſuch common colours which are as eaſily made with madder. The ſtuff is to be boiled with a quantity of alum and tartar, proportioned to the red ſhade of madder intended; it is then paſſed through a liquor of this root, and afterwards dipped and worked in a liquor of walnut roots or walnut rinds; the following colours will be produced, viz. cinnamon, tobacco, cheſnut, muſk, bear's hair, and numberleſs others, by varying the ground of the madder from the browneſt to the lighteſt, and keeping them longer or ſhorter in the liquor of the root. The proceſs may begin within any one of theſe colours, but the red is commonly dyed firſt, as the liquor proper for the madder might hurt the brown, therefore they are not to be mixt as the red and yellow are ſometimes.

CHAP. XXIV.

OF THE MIXTURE OF YELLOW AND BROWN.

FROM this mixture are produced the ſhades of feulemort and bear's hair.

Soot is commonly uſed in theſe colours inſtead of the rinds of walnuts, or the root of the walnut tree, as it makes them finer, but care muſt be taken that the wool or ſtuff be well ſcoured after it is dyed, to take off the bad ſmell of the liquor; for only the clear liquor of the ſoot is to be uſed, as has already been ſaid. The walnut rinds are preferable to the ſoot, unleſs obliged to match a pattern of feulemort with the greateſt exactneſs, and which may ſometimes be done with the walnut.

Theſe are the only two browns reſulting from theſe ſhades, the ſumach and the alder bark not giving ſufficient ground.

Wool muſt be boiled in alum and tartar to dye it yellow before it is made brown; but if it ſhould not have a ſufficient ground of yellow, it might be paſſed afreſh through the yellow dye, notwithſtanding it has been browned, though in fact this method of ſeeking exactly the ſhade does not make ſo laſting a colour as when the yellow was at firſt ſufficiently dyed; for when the yellow is dyed firſt, the brown is a great deal brighter.

CHAP.

CHAP. XXV.

OF THE MIXTURE OF BROWN AND BLACK.

FROM this mixture a great number of colours may be extracted, as coffee, cheſnut, prune, muſk, thorn, and ſeveral like ſhades, whoſe numbers are almoſt infinite, and of great uſe. The method of working them is this:

After the wool or ſtuffs have been made brown, as already deſcribed, and that ſeveral ſhades have previouſly been given; as for example, a ſtronger brown for the coffee, cheſnut, &c. galls, ſumach, and elder bark are put into a copper in proportion to the quantities of ſtuff to be dyed; the whole is boiled for one hour, after which green copperas is to added. The ſtuffs that are to be lighteſt, as the thorn, are firſt dipped in this liquor, then taken out, and others that are to be browner are put in, obſerving to add copperas to the liquor each time, and as occaſion may require, which is known by its not browning the ſtuff quickly, thus continuing until all the ſtuffs are browned: the liquor muſt not boil, nor be of a greater degree of heat than the hand can bear.

When the galls and other ingredients are boiled, cold water is added to refreſh the liquor before the ſtuff is put in: this is a precaution that is abſolutely neceſſary, as I have often ſaid. The ſtuffs are firſt to be dipped in luke-warm water before they are put into the copper, leſt ſince they were browned they ſhould have dried; and they muſt be aired when they have remained ſome time in the browning, by paſſing them between the hands by the liſts, without which they would perhaps ſpoil, blot, and be unequally dyed, and the brown, for want of airing, ſtiring, would not be laſting, as there would not be a ſucceſſive congelation of the ſaline parts of the vitriol.

I have now ſhown all the neceſſary colours or ſhades which may be produced by the mixture of the primitive colours taken two by two, and have given a minute deſcription both of their effects and the method of producing them. There being but few colours which may not be greatly varied, it depends on the judgment of the Dyer to chooſe the eaſieſt, provided the colour be equally fine.

CHAP. XXVI.

OF THE MIXTURE OF THE PRIMITIVE COLOURS, TAKEN THREE BY THREE.

FROM blue, red, and yellow, the red olives and greeniſh greys are made, and ſome other like ſhades of little uſe only for ſpun wool deſigned for tapeſtry. It would be a repetition to give the method of uſing theſe colours, having ſufficiently explained it in the preceding pages.

In the mixture, where blue is a ſhade, it is uſual to begin with it; the ſtuff is afterwards boiled to give it the other colours, in which it is dipped alternately one after the other; notwithſtanding they are ſometimes mixed together, and are as good, provided they are colours which require the ſame preparation; for example, the madder-red and the yellow. As to the cochineal and kermes, they are ſeldom uſed in theſe common colours, but only light colours which have a bloom or vinous hue, and which muſt be bright and brilliant, and then they are not uſed in the laſt liquor, that is, the ſtuff is only dipped in when it has received the other colours, unleſs they are to be greyed a little, which is laſtly done by paſſing them through the browning. It is impoſſible to give any preciſe rules for this work, and the leaſt practice of theſe rules will teach more than I could ſay in many volumes.

Olives are made from blue, red, and brown, from the deepeſt to the lighteſt, and by giving a little ſhade of red, the ſlated greys, the lavender greys, and ſuch like.

From the blue, the red, and the black, an infinite number of grey of all ſhades are made, as the ſage grey, the pigeon grey, the ſlate grey, the lead grey, the king's and prince's colour, browner than uſual, and a variety of other colours almoſt innumerable.

From yellow, blue, and brown, are made the greens, gooſe dung, and olives of all kinds.

From brown, blue, and black, are produced the brown olives and the green greys.

From the red, yellow, and brown, proceed the orange, gold colour, marigold, feulemort, old carnations, burnt cinnamon, and tobacco of all kinds.

From the red, yellow, and black pretty near the ſame as the laſt, and the deep feulemort; as alſo the ox hair and brown nut, and others of the like kind.

I give this liſt of colours only as a table to ſhow in general what ingredients are made uſe of to make theſe ſorts of colours, which alſo partake of ſeveral others

Four or five of theſe colours may be mixed together; however this is rarely done: a minute detail on this ſubject would be uſeleſs, becauſe all that may be done is oftentimes ſuperfluous. I ſhall now only relate the manner in which I have ſeen about forty different ſhades of carnations made in ſpun wool; this example will ſhow what may be done in all other caſes. There were none of thoſe bright ſhades of ſcarlet in theſe which are made as in the chapter on that colour.

Variety of Carnation Colours.

All theſe fleſh or carnations were old carnations, or ſhades of it, ſo that they were all obliged to be taken from the mixture of the red of kermes, yellow, brown, and black.

An unequal preparation was firſt given to the wool, reſerving for the lighter ſhades thoſe whoſe preparing liquors had been weakeſt. When they had remained as uſual four or five days in the liquor, the lighter ſhades were dyed; theſe colours were diſpoſed in four different veſſels, which were always kept ſufficiently hot without boiling. A ſkain of wool was immediately dipped in the liquor of the kermes for a minute, it was taken out, wrung, and paſſed through a liquor of weld, and an inſtant after through a brown one, and it became of the colour required by the Dyer; he immediately dipped another, which remained a litle longer in each liquor: he went on after this manner, and when, after being ſtrongly wrung, and ſeemed to want a little red or any other colour, he dipped it in the liquor which it appeared to want. By this method he brought all his colours to the deſired ſhade, and paſſed through the brown thoſe that were required to be deeper. I was fully perſuaded by this method of working, that only patience and practice were wanting to make all the colours which can be conceived.

Too much caution cannot be given in this kind of work, to begin always with the lighteſt ſhades;

for it often happens that they are kept too long in ſome of theſe liquors, and then that ſkain muſt be made into a darker ſhade. But when once the lighter ſhades are matched, and in a right degradation, the reſt are eaſily made.

What I have been ſpeaking of, relates only to wool intended for tapeſtry, when it is neceſſary that the ſhades be carried on with the greateſt degree of preciſion, without which it would be impoſſible to imitate the fleſh colours of the painter.

With regard to ſtuffs, it ſeldom or never happens that they are made in theſe gradations of ſhades, or that ſo many colours are mixed together; two or three are generally ſufficient, ſince it has been ſhown what a variety of colours aroſe from their combination, that even names cannot be found for them.

I think I have omitted nothing regarding the dying of wool or woollen ſtuffs in the great and good dye, and I make no doubt but that by exactly following what I have laid down, each colour and all the ſhades may be executed to the greateſt perfection, as well in fleece wool, ſpun wool, as on ſtuffs manufactured in white.

I think it yet neceſſary to add ſomething in regard to mixed ſtuffs, that is, whoſe wool is mixed before the manufacturing of the ſtuff, and to teach the method by which this mixture of dyed wool is performed, to be afterwards carded and ſpun to form a colour reſulting from thoſe different wools.

It may be objected, that this article rather relates to the manufacturing of ſtuffs than their dyes; but to this I anſwer, that ſometimes colours are made by mixing wool of different ſhades, whoſe colours would not eaſily be imitated by dying the ſtuff of a compound colour; ſome of theſe different ſhades compoſed of ingredients which would require a different preparation; whereas by dying every part of the wool ſeparately, the mixture is made without any difficulty; it cannot therefore be improper here to give the manner of mixing together wool of different colours, and I ſhall alſo give the manner of making mixtures for an eſſay or proof in ſmall, (which is always neceſſary) to chooſe that which produces the moſt agreeable effect.

CHAP. XXVII.

OF THE MANNER OF MIXING WOOL OF DIFFERENT COLOURS FOR CLOTHS OR MIXED COLOURS.

Colours mixed in the Loom.

ONE example of the method of mixing (after the moſt exact manner poſſible) wool of different colours, will be ſufficient, and it will be eaſily applied in all other caſes required. Suppoſe a mixed cloth of a coffee colour to be made, the following is the method of the manufacturers of Languedoc, and pretty near the ſame is practiſed in all other manufactories.

Three hundred and fifty pounds of wool are firſt dyed coffee colour, which is called the ground wool, that is, that which prevails in the ſtuffs; after which are taken five pounds of wool dyed in madder-red or kermes, and two pounds dyed in king's blue; theſe laſt are called the wool of mixture. This wool is diſtributed to different perſons placed in a ring in a large room. The factor, or he that has the care of the mixture,

ſtands

ſtands with a ſtick in his hand in the centre of this circle, the men being at ſix feet diſtance from him; eight or ten are generally employed at this work, and all the wool is given to them. In the preſent caſe, for example, ſix will be employed in bearing the prevailing wool or coffee colour, one the blue, and another the red; but they muſt be ſo ſituated that there may be three together who have the coffee coloured wool, then he that has the red, then three with the coffee colour, and laſtly he that has the blue. When there is a greater number of colours, they are thus equally diſtributed, obſerving to divide them, as much as poſſible, the one from the other.

The men thus diſpoſed walk ſlowly round the factor, keeping an equal diſtance, and each ſtep they take they caſt at the feet of the factor a ſmall lock of the wool they carry, with this difference, that thoſe that have the red or the blue, having but a ſmall quantity to diſtribute, fling but little each time, whereas the others muſt fling much more. The factor ſtirs the wool with his ſtick whilſt the men are flinging it, and that the mixture ſhould be perfect, they muſt all have diſtributed their wool at one and the ſame time. The factor then mixes it again, and gives it to the carders.

The carding makes a perfect mixture, ſo that no particular colour is to be diſtinguiſhed, and it appears of one uniform colour; it is afterwards ſpun, the cloth manufactured, and brought to the mill. The importance of this mixture being exactly made is eaſily conceived, for if theſe colours were unequally diſtributed, the cloth would appear full of blots.

As in the compoſition of theſe mixtures it is not poſſible to judge exactly of the effect which may be produced by the combination of all theſe colours in different proportions, I ſhall give a method of making a proof in ſmall, that a colour formed after this manner by a known proportional mixture, it may be executed in great, and be certain that the colour of the ſtuff will be equal to that of the pattern.

CHAP. XXVIII.

OF THE METHOD OF PREPARING THE PATTERN FELTS, OR MIXTURE FOR AN ESSAY.

THIS little work is very ſimple and very uſeful, as it will ſhow in an hour what a mixt cloth will be after it is manufactured, and even when it is entirely dreſſed. For this purpoſe, wool of different colours are taken, and after having weighed each exactly, the mixture is made with the fingers in the proportion which is judged ſufficient, but the whole in a very ſmall quantity; ſo that the mixture being made, it may not exceed the bigneſs of the fiſt. This wool is then moiſtened with a little oil, and carded ſeveral times with ſmall cards, till all theſe colours are well incorporated together and perfectly well mixt. This wool, which is extremely open and of the ſquare form of the card, is folded four times, and gently preſſed between the hands. It is then plunged into a ſtrong ſoap water, and putting it again between the hands, it is ſtrongly preſſed at different times, ſtriking ſometimes one hand on the other. It is then gently rubbed betwixt the two hands, which hardens the wool by contracting it all manner of ways, and making it occupy leſs ſpace. It is then dipped again in the ſoap water, and continued to be felted, until it has acquired ſome conſiſtence, and that it becomes like felt, and pretty near the ſame conſiſtence as the common cloth. This felt is then a true copy of what the cloth will be after its manufacturing; for when it has been well felted, that is, that the wool has been equally and carefully extended under the hand coming from the card, it is as equal and as ſmooth as the cloth itſelf can be. To finiſh it alſo as perfectly as the cloth, after it has been waſhed to take off the ſoap, it is dried and put between two papers, and preſt with an iron ſomewhat hot: by this means it acquires a luſtre which makes it appear like a cloth which has been entirely dreſſed.

If the colour of the felt is approved of, the mixture in great is made for the cloth, by following the ſame proportions exactly, and it will certainly be like the pattern, for not only the wool of different colours are as entirely mixt and cloſed one to the other in the felt as in the cloth, but the ſoap which has been made uſe of to felt it, has produced the ſame effect as that which happens to the cloth in the fulling-mill, for there are ſeveral colours, and particularly thoſe that have been browned, that is, in whoſe compoſitions there are ſhades of black and grey, which loſe in the mill part of their browning, ſo that it muſt always be dyed of a deeper colour than intended to be after finiſhing: this defect of ſolidity in the browning does not hinder it from ſtanding very well the action of the air, but it is eaſily ſpotted by acid liquors, as has been before ſaid. The colours that have been ſaddened in the woad or indigo vat are not liable to this, they ſcarce loſe any thing in the mill. The felt produces the ſame effect, and it is certain that the ſtuff will not loſe more in great at the mill than the felt did with ſoap; conſequently this preliminary operation of the felt may be looked upon as a ſure guide for the choice and aſſortment of wool in mixt cloths.

Theſe patterns are made ſtill better with black ſoap, but it gives them a diſagreeable ſmell, which is not eaſily taken off by repeated waſhings.

The felts, when made, may be dyed for ſtuffs, in which it is required that one colour ſhould cover the other, for then, after the ſtuff ſhould have been mixt with the ſame colours as the felt, it might be dipt in the ſame dye through which that had been paſſed, and by this means it would be of the ſame colour as the felt; but this is not to be done to the ſtuff till it comes from the mill, has been ſheered, and nothing remains but to dreſs it. This method will be of great uſe when it is a mixt cloth in which cochineal has been uſed, for it ſaddens too much and ſpoils at the mill; ſo that when it is uſed in mixt ſtuffs, a freſh liquor muſt be made, in which the cloth muſt be dipt, when it requires no more dreſſing than that which is given to cloth dyed white after it is come out of the dye.

CHAP. XXIX.

POLISH RED.

BEFORE I enter upon the colours of the leſſer dye, I ſhall give the proceſs of a very excellent colour, called Poliſh red.

If you would dye forty pounds of wool this bright and holding colour, boil ten pounds of nut galls, in a copper ſufficiently large, an hour and a half; then cool the liquor with cold water about ten degrees under a boiling heat, becauſe the madder ſhould not boil, and add beſt madder in proportion to the ſhade required, from fourteen to twenty pounds. Work theſe ingredients with the wool for two hours with long poles, that it may dye in all parts alike. Rince it well, and you have the true poliſh red. If you would have a dark colour, uſe a little aſhes. Obſerve to have the wool well ſcoured. This proceſs will hold good in cloth and other things.

THE

THE

DYER's ASSISTANT.

PART II.

CHAP. I.

OF THE DYING OF WOOL BY THE LESSER DYE.

I Obſerved in the beginning of this Treatiſe, that the dying of wool, or woollen ſtuffs manufactured from it, were diſtinguiſhed by the great and leſſer dye. The French regulations have fixed what the quality of the wool and ſtuffs are to be, which are to be dyed by the great or leſſer dye. This diſtinction has been founded on this principle, that ſtuffs of a certain value, and which generally conſtitute the upper part of clothing, ſhould receive a more ſolid and laſting colour than ſtuffs of a low price, which would be dearer and become leſs ſaleable, were they obliged to be dyed by the good dye, as the good dye is a great deal more expenſive than the leſſer, and that ſtuffs of low price, which are permitted to be dyed by the leſſer dye, are generally uſed to make linings, ſo that they are little expoſed to the action of the air, and if they are put to other uſes they are ſoon worn out, on account of the weakneſs of their texture; and conſequently there is no neceſſity for their colours being ſo laſting as that of a ſtuff of a much longer duration.

I have related in the preceding treatiſe, with the greateſt exactneſs and preciſion in my power, the method of executing by the good dye all imaginable colours; I ſhall do the ſame in that which concerns the leſſer dye, and ſhall lay down the method of making the ſame colours with other ingredients than I have hitherto ſpoken of, and which, though they have not the ſolidity of the firſt, often have the advantage of yielding more lively colours; beſides which, the greater part give a ſmoother colour, and are worked with greater facility than the ingredients of the good dye.

Theſe are the advantages of theſe ſubſtances which are called falſe ingredients, and though it is to be wiſhed that their uſe was not ſo general, it muſt be agreed that they have their utility for ſtuffs leſs expoſed to the air, or whoſe colour does not ſtand in need of a long duration. I might alſo add, that the colours are moſt commonly ſorted with greater eaſe, and with more expedition, in the leſſer dye than can be done in the great.

I ſhall not follow the ſame order for this kind of dye as I did for the good, ſince in this no primary colours are known. Few ſerve as a ground for others: the greateſt part do not ariſe from a combination of two or ſeveral ſimple colours. In ſhort, there are colours, ſuch as the blue, &c. which are ſeldom or never made in the leſſer dye.

This is the order which I propoſe to follow, and ſhall firſt ſet forth the names of all the ingredients which particularly belong to the leſſer dye, and then give the method of uſing each of theſe ingredients, and the extraction of all the colours they can yield.

It will be found that ſeveral of theſe ingredients produce ſimilar colours, ſo that it would have been impoſſible to have treated of them ſeparately, without tiring the reader with tedious and troubleſome repetitions.

The ingredients are flock or goat's hair maddered, archil, logwood, braſil, fuſtic, roncou, grains of *Avignon*, turmeric, or *terra merrita.* I ſhall not here ſpeak of the ſanders or ſoot, though theſe ingredients particularly belong to the leſſer dye; I have already given the manner of uſing theſe laſt.

CHAP. II.

OF THE DYING OF FLOCK OR GOAT'S HAIR.

THERE are two preparations very different one from the other in the dying of flock: the firſt is with madder, and belongs to the great and good dye; the ſecond is to diſſolve it and make uſe of it; this belongs to the leſſer dye The dying with flock was formerly permitted in the good dye, but was rather on account of its being extracted from madder, than by any experiment that had been made concerning its durability. I tried it with great attention, and found it beyond any doubt that there is no colour that reſiſts the air leſs. It is certainly for this reaſon that it was reſtrained to the leſſer dye in the new regulation of France in 1737. Yet, as by the ſame regulation, it is not permitted to the Dyers of the leſſer dye to uſe madder, nor even to keep it in their houſes; it has been enacted, that only the Dyers of the great dye ſhould be ſuffered to madder flock, and thoſe of the leſſer dye to diſſolve and uſe it.

This maddering of flock ought to have found a place in the foregoing Treatiſe, but that I choſe rather to claſs together all operations that have any neceſſary connection, than to ſtick too ſcrupulouſly to that diſtinction of the great and leſſer dye, which is the particular object of the civil government of that art, and which upon ſome occaſions might have made me fall into ſome obſcurities, or run into continual repetitions; beſides, the government of dying is not the art conſidered in itſelf.

To madder the flock or goat's hair, four pounds of either of them is cut and well ſeparated, that the dye may penetrate the better. It is boiled two hours in a ſufficient quantity of ſour water; then it is drained for an hour, and put into a middling copper, half filled with water, with four pounds of roach alum, two pounds of red tartar, and one pound of madder. The whole is boiled for ſix hours, putting in hot water as the liquor waſtes; it is left all night and next day in this liquor; the third day it is taken out and drained in a baſket. Some Dyers let it remain eight days, but it often happens that by this delay in a copper veſſel it is tarniſhed by the liquors corroding a part of the copper; a middling copper is then filled to the two-thirds with half ſour water and half common water, and when the liquor is ready to boil, eight pounds of madder, well cut and cruſhed between the hands, is added. When the madder is well mixed in the liquor, four pounds of flock or hair is put in and boiled for ſix hours; it is then well waſhed, and the next day it is maddered a ſecond time after the ſame manner, only putting in four pounds of madder inſtead of eight, which were before uſed. After this ſecond maddering, it is well waſhed and dried; it is then almoſt black and fit for uſe.

It appears by this operation, that four pounds of flock or hair is loaded with thirteen pounds of the dye of madder, yet there ſtill remains ſome Dye in the liquor, which is then called an old maddering, and which is preſerved for uſe on certain occaſions, as in tobacco, cinnamon colour, and ſeveral others.

When the flock is thus maddered by the Dyer of the great dye he ſells it to Dyers of the leſſer, who have then the liberty to diſſolve and uſe it; this is the common method, which has many difficulties, and is known but to few Dyers. Madder is hereby made fine.

About half an hour after ſeven in the morning, ſix pails full of clear water are put into a middling copper, and when the water is lukewarm, five pounds of pearl-aſhes are put in: the whole is boiled till eleven, and the liquor is then conſiderably diminiſhed, ſo as to be held in a leſſer copper, into which it is emptied, obſerving firſt to let the dregs of the pearl-aſhes ſubſide, that none but the clear may be uſed.

A pail full of this liquor is afterwards put into the middling copper, having firſt ſcoured it well, and a little fire made under it; the four pounds of maddered flock are ſcattered in by degrees, and at the ſame time a little of the lukewarm and ſaline liquor of the ſmall copper is added to keep down the boiling, which riſes from time to time to the top of the copper, in which the operation is performing.

When all the flock and the liquor of the little copper are put into the middling one, a pail full of clear water is put on the dregs of the pearl-aſhes remaining in the little copper. This water ſerves to fill the middling one as the liquor in it evaporates. All this flock melts, or is diſſolved by the action of the pearl-aſhes, and after the firſt half hour, not the leaſt hair is to be perceived. The liquor is then of a very deep red. The whole is then boiled without any addition, till three in the afternoon, that the whole diſſolution of the flocks may be the more exactly performed. Then a ſtick is placed upon the copper, and upon this ſtick is placed a pail of fermented urine, in which pail a ſmall hole has been previouſly made towards its lower part, and a little ſtraw put into it, that the urine may very ſlowly run into the copper; whilſt it is running, the liquor is made to boil ſtrongly, and this urine makes good what may be loſt by evaporation. This operation continues five hours, during which time three pails full of urine are diſcharged into the copper, being made to run faſter when the boil is ſtronger, than when moderate. It is here to be obſerved, that, on account of the ſmall quantity of flock in the experiment which I lay down here, five pounds only of pearl-aſhes are ordered; for when thirty pounds of flock are diſſolved at one time, which is the common cuſtom of the French Dyers, they put twelve ounces of pearl-aſhes to each pound of flock.

During the whole time of this operation, a ſtrong volatile ſmell of urine is emitted, and there ſwims on the ſurface of the liquor a brown ſcum, but much more ſo after the addition of the urine. The liquor is known to be ſufficiently done when this riſes no more, and that the boil riſes but gently, that is what happened to the operation now related, at eight in the evening. The fire is then raked out, the copper covered, and thus left to the next day. Patterns had been taken at different times of the colours of the liquor from three to eight in the evening, by dipping in ſmall pieces of paper: the firſt were very brown, and they became continually lighter, and united themſelves more and more, in proportion as the volatile part of the urine acted on the colouring parts of the liquor.

Nothing now remained but to dye the wool in the liquor thus prepared, and which is called melting of flock; this is the eaſieſt work belonging to the Dyer. A quarter of an hour before the dying is begun, a little piece of very clean roach alum is put in, and the copper is well raked to melt it. As this liquor which was in the middling copper had been covered the whole night, and the fire had not been put out, the liquor was ſtill ſo hot as not to ſuffer the hand. The cleareſt was taken out and brought into a ſmall copper, with a ſufficient quantity of lukewarm water, ſome wool dyed yellow with weld was dipped in it; it immediately became of a fine orange, bordering on the flame colour, that is of the colour called *nacaret*, and known to the Dyers by the name of *nacaret of flock*, becauſe it is commonly made with melted flock.

Twenty hanks of white wool were dipped one after the other in the ſame liquor, beginning by thoſe that were to have the deepeſt ground, and leaving them longer or ſhorter in the liquor according to the ſhade required. An aſſortment was made after this manner from the nacaret, or bright orange red, to the cherry colour. It ought to be obſerved, that in proportion as the liquor was conſumed, freſh was taken from the middle-ſized copper, great care being taken not to ſtir the ſediment at the bottom; a little fire was alſo kept under the ſmall copper, to keep the liquor always in the ſame degree of heat. The wool is thus dipped until the whole liquor is uſed, and all the colour drawn out. But the lighter colours could not be dyed in it; for when the colour of the liquor is once weakened, as it ought to be for theſe colours, it is generally loaded with filth, which would take off the brightneſs required in theſe ſhades.

The following is the method of making ſhades lighter than the cherry colour. A copper is filled with clear water, and five or ſix hanks of wool dyed of the deepeſt dye from the flock, that is, from the ſhade that immediately follows the nacarat, are put in. As ſoon as the water boils, it takes out all the colour the wool had, and it is in this freſh liquor that the other wool that is to be dyed is dipped, from the cherry colour to the paleſt fleſh colour, obſerving always to begin by the deepeſt ſhades.

Moſt of the Dyers who do not know how to melt the flock, or who will not give themſelves that trouble, buy ſome pounds of this ſcarlet of flock, which they uſe after this manner, to make all the lighter ſhades, which, as has been ſaid, is done with much eaſe. This operation ſhows what little dependence can be put on the ſolidity of a colour that paſſes ſo quickly in boiling water. And in fact, it is one of the worſt colours there is in dying, and on that account the new regulation has taken it from the great dye, and permits it in the leſſer for the reaſons above mentioned.

Thus a very bad colour may be had from an ingredient which, of all thoſe that are uſed in dying, is perhaps the beſt and the moſt durable; yet when this hair, dyed with all the neceſſary precautions to inſure the colour as much as poſſible, comes to be diſſolved or melted in a liquor of pearl-aſhes, its colour, by acquiring a new luſtre, loſes all its ſolidity, and can only be ranked in the number of the falſeſt dyes.

It may appear that the little ſolidity of this colour proceeded from the wool having no preparation, and retaining no ſalt before its being dipped in the diſſolved flock; but I found that this was not the cauſe; for I dipped in this liquor wool boiled as uſual, and other wool differently prepared, without finding that the colour of the latter had acquired any more ſolidity; the luſtre was leſs, that is, it came out more ſaddened than the wool that had been dyed in it without any preparation.

Though I have ſaid that wool receives no preparation before its being dyed in a diſſolution of flock, it is nevertheleſs neceſſary to ſulphur thoſe that are to make clear ſhades, for that gives them a great brightneſs and luſtre, as the diſſolved flock is applied on a ground a great deal whiter than it would be without the vapour of the ſulphur, which cleanſes it of all its filth. The ſame thing is done for the light blues, and for ſome other colours; but this operation is ſeldom made uſe of but for wool intended for ſamples or tapeſtry.

Sulphuring of Wool.

The Dyers do not do this, becauſe of the ſtink of the ſulphur, or rather to avoid the trouble. Nevertheleſs, to give an idea of it, the white wool is ſuſpended on hoops or perches in a cloſe room, and under this wool chaffing-diſhes are placed with lighted coals, on which powdered ſulphur is caſt. The room-door is afterwards ſhut, that the ſmoke may be the longer retained and act on the wool, which is to remain till it is entirely whitened; it is then called ſulphured wool; and this is the preparation it muſt receive to give a brightneſs to the roſe, cherry, and fleſh colours, which are made from the diſſolution of flocks.

The Theory of the Diſſolution of Flock.

The reaſon why from an ingredient, ſuch as the root of madder, periſhable colours are produced from diſſolved flock, is not difficult to aſſign. In the firſt operation of maddering the flock, the red of the madder was fixed in the hair by the preparation of alum and tartar as much as poſſible, but as it is overloaded with this colour, it is eaſy to conceive that the ſuperfluous colouring atoms being only applied on thoſe which already filled the pores of this hair, theſe alone are really retained in the pores, and are cemented by the ſalts. The hair thus reddened by the madder ſo as to become almoſt black, would loſe a great deal of the intenſity of its colour, if it was boiled in any liquor, was it even common water; but to this water, pearl-aſhes are added in equal weight with the flock already dyed, which is to be melted in it; conſequently there is a very ſtrong lixivium of fixed alkaline ſalts made. I have already ſaid in another place, in the foregoing Treatiſe, that very ſtrong alkaline leys deſtroy the natural texture of almoſt all animal ſubſtances, as alſo gums and reſins; in ſhort, that an alkaline ſalt is their diſſolvent. In the preſent operation, the lixivium of the pearl-aſhes is very concentrated, and very acrid, and conſequently in a ſtate to melt the hair, which is an animal ſubſtance, which it does very quickly, and with a ſtrong fermentation, which ſhows itſelf by the ſtrong and violent elevation of the liquor; conſequently it deſtroys the natural texture of each of theſe hairs, and the ſides of the pores being at the ſame time broken and reduced to very minute parts, theſe ſides having neither conſiſtence nor ſpring to retain theſe ſalts, and the colouring particles that were ſticking to them. Therefore the animal particles of the hair, the colouring parts of the madder, the ſaline parts of the liquor, and the alkali of the pearl-aſhes, are all confounded together, and form a new mixture, which cannot afford a laſting dye, becauſe from theſe ſaline parts mixed together there cannot be formed a ſufficient quantity of ſalts capable of cryſtalization, and producing moleculas, which can reſiſt cold water and the rays of the ſun. In ſhort, it could not form a tartar of vitriol, becauſe the alkaline ſalt is in too great a proportion.

To rouze the deep and overloaded dye of the madder firſt applied on the flock, and after confounded by the melting of this hair in the mixture already ſpoken of, putrified urine is added in a conſiderable quantity; this is a further obſtacle to cryſtalization; conſequently wool not prepared by other ſalts, and dipped in a liquor thus compoſed, can only be covered by a ſuperficial colour, which finds no prepared pores, or any thing ſaline in thoſe pores, which may cement the colouring atoms; therefore ſuch a dye muſt quit its ſubject on the leaſt effort of what nature ſoever it be.

But wool prepared by the liquor of tartar and alum, does not take a more laſting colour, in the liquor of the melted flock, than wool not prepared by theſe ſalts; for a liquor which abounds with fixt alkaline ſalts attacks the tartar left of the preceding preparation in the pores of the wool. This tartar changes its nature, and from being hard to diſſolve, as it was before, it becomes a ſoluble tartar, that is, a ſalt that diſſolves very eaſily in the coldeſt water.

It may perhaps be objected, that particles of alum remain in the pores of the prepared wool, that from theſe particles of alum, as well as from a portion of the ſame ſalt which is put into the liquor, reddened by the melting of the flock, the alkali of the pearl-aſhes muſt form a tartar of vitriol, which, according to my principles, ought to ſecure the dye.

To this I anſwer, that the urine hinders the combination of theſe two ſalts, which is neceſſary for the formation of the tartar of vitriol; if even this hindrance did not exiſt, the quantity of this ſalt, which I have named *hard* in another place, could not be ſufficient to cement the colour in the pores of the wool, or put them in a ſtate to retain the colouring atoms. Further, the ſharpneſs of the alkaline ſalts in this liquor, which is capable of entirely diſſolving the hair boiled in it, would equally be able to diſſolve the wool, were it boiled as the flock was. But yet, though a degree of heat is not given to the liquor, which would be neceſſary for this total deſtruction, it is eaſily conceived, that if the ſum of the deſtroying action is not the ſame, at leaſt a part exiſts, which is ſtill ſufficient to corrode the ſides of the pores of the wool, to enlarge them greatly, and to render them unfit to retain the colouring atoms; to this may be added, that the hair is melted in the liquor, and conſequently mixt with the colouring parts of the madder in a great quantity; that theſe are heterogeneous parts, which prevent the immediate contact of the ſame colouring parts, and that from all theſe obſtacles taken together, the colour muſt be rendered leſs durable and leſs holding than any of the leſſer dye. This, experience ſufficiently proves, for if a ſkain of red wool dyed in this manner, be put into boiling water, the colour will be taken off entirely.

CHAP.

CHAP. III.

OF THE MANNER OF USING ARCHIL.

ARCHIL is a ſoft paſte, of a deep red, which being ſimply diluted in hot water affords a number of different ſhades; there are two kinds, the moſt common which is not ſo fine or ſo good, is generally made in Auvergne, of a lichen or ſort of moſs, very common on the rocks of that province: it is known under the name of Archil of Auvergne, or Land Archil. The other is a great deal finer and better; it is called the Archil of Herb, or of the Canaries, or Cape Verd Archil; it is prepared in France, England, Holland, and other places.

The workmen who prepare this herb Archil, make a ſecret of the preparation, but the particulars may be found well related in a Treatiſe of M. *Pierre Antoine Micheli*, which bears for title, *Nova Plantarum Genera*, therefore I ſhall not here give the method of preparing it.

When a Dyer wants to aſſure himſelf that the Archil will produce a beautiful effect, he muſt extend a piece of this paſte on the back of his hand and let it dry, afterwards waſhing his hand with cold water. If this ſpot remains with only a little of its colour diſcharged, he may judge the Archil to be good, and be aſſured it will ſucceed.

I ſhall now give the method of uſing the prepared archil, but I ſhall only treat of that of the Canaries, and juſt mention the difference between it and that of Auvergne. A copper is filled with clear water, and when it begins to be luke-warm, the proper quantity of archil is put in and well ſtirred: the liquor is afterwards heated almoſt to boiling, and the wool or ſtuffs are dipt without any preparation, only keeping thoſe longer in that are to be deeper.

When the archil yields no more colour at this degree of heat, the liquor is made to boil to extract the remainder; but if it is archil of Auvergne, the colours drawn after this manner will be fadder than the firſt, on account of the boiling of the liquor. The Canary archil, on the contrary, will loſe nothing of its brightneſs, if even the liquor boiled from the beginning. This laſt, though dearer, yields much more dye, ſo that there is more profit in making uſe of it, beſides its ſuperiority over the other in beauty and goodneſs of colour. The natural colour which is drawn both from the one and the other archil, is a fine *gris-de-lin*, bordering on the violet. The violet, the panſy, the amaranth, and ſeveral like colours are obtained from it, by giving the ſtuff a ground of blue more or leſs deep before it is paſſed through the archil.

It muſt here be obſerved, that to have the clear ſhades of theſe colours as bright as they ought to be, the wool ought to be ſulphured, as was ſaid in the foregoing chapter, either before it is dipped in the archil, for the *gris-de-lin*, or before it is dyed blue for the violet and other like colours.

This way of uſing archil is the ſimpleſt, but the colours that proceed from it are not laſting. It may be imagined that the colours would be better by giving a preparation to the wool previous to its being dyed, as is practiſed in the great dye, when madder, cochineal, weld, &c. are uſed; but experience ſhows the contrary, and I have uſed the archil on wool boiled in alum and tartar, which did not reſiſt the air more than that which had received no preparation.

There is, notwithſtanding, a method of uſing the Canary archil, and giving it almoſt as much duration as the moſt part of the ingredients of the good dye; but then its natural colour of *gris-de-lin* is taken off, and it acquires a red or ſcarlet, or rather a colour known under the name of baſtard ſcarlet. The colours of the kermes or Venetian ſcarlet, and ſeveral other ſhades that border on the red and the orange, may alſo be drawn from it. Theſe colours are extracted from the archil by the means of acids, and all thoſe that are thus made may be looked upon as much more laſting than the others, though ſtrictly-ſpeaking, they are not of the good dye.

There are two methods of extracting theſe red colours from the archil. The firſt is by incorporating ſome acid in the compoſition itſelf that is made uſe of to reduce this plant to a paſte (ſuch as is known to the Dyers under the name of archil). I have been aſſured that it may be made violet and even blue, which probably is done by the mixture of ſome alkalis, but I muſt confeſs I could not ſucceed in it, although I made above twenty trials for that purpoſe. I ſhall now proceed to the ſecond method of extracting from archil a beautiful and pretty laſting red, and which I executed four times with ſucceſs.

Baſtard Scarlet by Archil.

Prepared archil from the Canaries is diluted as uſual in warm water, and a ſmall quantity of the common compoſition for ſcarlet is added, which is as has been ſhown in the preceding treatiſe, a ſolution of tin in *aqua-regia*, weakened with water; this acid clears the liquor immediately and gives it a ſcarlet colour. The wool or ſtuff is then to be dipped in this liquor, and left till it has received the ſhade required. If the colour ſhould not have brightneſs enough, a little more of the compoſition muſt be put in, and pretty near the ſame method muſt be followed as in the dying of common ſcarlet: I tried to make it in two liquors as the ſcarlet, that is, to boil the ſtuff with the compoſition, and a ſmall quantity of archil, and afterwards to finiſh it with a greater quantity of both, and I ſucceeded equally; but the operation is longer after this manner, and I have ſometimes made as fine a colour in one liquor. Thus the Dyer may take his choice of either of theſe methods.

I cannot exactly fix the quantity of ingredients in this operation. Firſt, As it depends on the ſhade that is to be given to the ſtuff. Second, As it is a new proceſs in dying, I have not had ſufficient experiments to know with exactneſs the quantity of archil and compoſition which ought to be uſed: the ſucceſs alſo depends on the greater or leſſer acidity of the compoſition. In ſhort, this method of dying with archil is ſo eaſy, that by making two or three trials in ſmall, more knowledge will be acquired from it than I could teach in a large volume: I muſt only add, that the more the colour drawn from this ingredient approaches the ſcarlet, the more laſting it is. I have made a great number of ſhades from the ſame archil, and which conſequently only differed by the greater or leſs quantity of the compoſition, and I always found that the more the archil went from the natural colour, the more laſting it became, ſo that when I brought it to the ſhade known by the name of baſtard ſcarlet, it withſtood the action of the air and eſſay proof almoſt as well as that which is commonly made with cochineal or madder.

If too much compoſition be put in the liquor, the wool will become of an orange colour, and diſagreeable. The ſame thing alſo happens with cochineal, ſo that this is not an inconvenience peculiar to this dye; beſides it is eaſily avoided by proceeding gradually in the addition of the compoſition, and by putting a ſmall quantity at firſt.

I have tried the different acids in this ſcarlet compoſition, but none ſucceeded well; vinegar did not give a ſufficient redneſs to the liquor, and the ſtuff dyed in it only took a colour of lees of wine, which even was not more laſting in the air than that of the archil in its natural ſtate, and other acids ſaddened the colour. In ſhort, it appears that (as in ſcarlet with cochineal) a metallic baſe extremely white muſt be united to the red of the archil, and this baſis is the calx of tin. I have repeated the ſame operation with the archil of Auvergne, but the colours were not near ſo fine or ſo good.

CHAP. IV.

OF LOGWOOD OR CAMPEACHY.

THE campeachy wood, known under the name of logwood, is of great uſe in the leſſer dye, and it were to be wiſhed that it was not uſed in the good dye, for the colour which that wood produces loſes its brightneſs in a ſhort time, and even diſappears in ſome places on being expoſed to the air; the low price of this drug in ſome meaſure tolerates its uſe; but the principal reaſon of uſing it is, that by the means of different preparations and ſalts it affords a great number of colours and ſhades, which are not eaſily made by the ingredients of the good dye alone. Yet it is poſſible, as I have ſaid before, to make all theſe colours without the help of logwood; therefore it was proper to forbid the uſe of this ingredient in the good dye.

Logwood is neceſſary to ſoften and velvet the blacks; it is this velvet hue that gives that excellency to the Sedan blacks. I ſhall now add ſome little matter concerning the other colours in which this wood is uſed, and I ſhall obſerve, that when any wood whatſoever is uſed in dying, it muſt be cut into ſmall ſhavings or chips, and put into a bag, that it may not ſtick to the wool or ſtuffs; for the rough chips will not only tear the goods, but blot them in thoſe places to which they ſtick.

Logwood is uſed with galls and copperas for all the ſhades of grey which border on the ſlate or lavender, the pigeon grey, the lead grey, and ſuch like. To make theſe, a copper is filled with clear water, and a proper quantity of galls is added; this muſt be proportioned to the quantity of ſtuffs to be dyed, and to the depth of the ſhade required. A bag of logwood is put into this liquor, and when the whole has boiled and cooled, the ſtuff is dipped in it, adding by little and little ſome copperas previouſly diſſolved in water. I cannot fix any exact proportion of ingredients, as the Dyers of the leſſer dye are not accuſtomed to weigh them; they work by the eye, and their buſineſs being to match low-priced ſtuffs for linings of cloths for which they have the patterns, they firſt make them lighter than is wanted, and ſadden them by adding copperas till they are come to the ſhade required. If they find there is not logwood ſufficient, they add more; they do the ſame when they have ſeveral ſtuffs to paſs through the ſame liquor, when they find the wood they have given has yielded all its dye. This work is not difficult, and only requires practice to judge pretty nearly the quantity of ingredients to be uſed, and to judge by the ſtuff, while wet, whether, when dry, it would have the intended colour, which is done by ſtrongly wringing the end, and blowing on it ſtrongly: by this means, the greateſt part of the humidity, which has by twiſting been brought to the ſurface of the ſtuff, is driven off; then for an inſtant the colour is ſeen pretty nearly ſuch as it will be when dry; but this muſt be done by a quick eye, for in a moment after the adjacent moiſture is communicated to this dry place, and then you may be deceived.

A pretty fine violet is alſo made with logwood, by firſt boiling the wool as uſual with alum and tartar, and afterwards paſſing it through a liquor of logwood in which a little alum is diſſolved. But it is made much finer by bluing and aluming the ſtuff firſt, then dipping it in a liquor of Brazil mixt with a little logwood; this violet, though of the leſſer dye, is much better than the former, becauſe the blue ground always ſuſtains the colour, and makes it more holding.

The logwood alſo affords a blue colour, but it laſts ſo ill that this wood is ſeldom uſed for dying blue. Yet if from curioſity you wiſh to make a trial, you need only prepare a liquor with logwood, and mix a little Cyprus or blue vitriol in it, and dip the ſtuffs in this without any other preparation, and you have a fine blue.

By the ſame means, green may be made in the ſame liquor. For this purpoſe, logwood, French berries or grains of Avignon and verdigriſe are put into a copper; this mixture gives the liquor a beautiful green colour; the wool may be then dipt to the height deſired, and may be of any deſired ſhade, by putting in more or leſs of the logwood and Avignon grains. But this colour is not better than the blue, and both ought to be excluded the art of dying: I have given the proceſs, merely that

I might omit nothing which came to my knowledge concerning the art.

The uſe to which logwood is moſt commonly applied in the leſſer dye is for plumb, prune colours, purples and their ſhades.

This wood joined with galls, readily gives all its colours to wool that has a ground of blue; it is ſaddened with a little green copperas, which browns them, and by this means ſome ſhades may be eaſily obtained which are much more difficult to hit in the great dye, as the different degrees of ſaddening are much more difficult to match in a blue vat, than by the help of the iron of the copperas. But theſe colours fade away very ſoon in the air, and in a few days a great difference is ſeen between the parts that were expoſed to the air and thoſe that were covered.

Having experienced, as I ſaid in the preceding chapter, that the ſcarlet compoſition changed the colour of the archil, and made it more laſting, I tried what effect it might produce on the logwood; but what appeared ſingular to me was, that whatſoever quantity of compoſition I put into this liquor, it never loſt its violet colour. Being deſirous to put this to a further trial, I dyed a piece of cloth with logwood, and put into the liquor a quantity of compoſition, pretty near equal to that which I would have put for an equal doſe of archil: the cloth took a pretty good violet colour. This cloth was put in the weather for twelve ſummer days, and the colour proved no better than if no compoſition had been uſed. By adding a ſmall quantity of cryſtals of tartar to another liquor compoſed as the former, I had a more laſting colour, but conſiderably different.

The Raven Grey.

The raven grey on worſted or ſtuffs is performed in the following manner.

In a copper ſufficiently large for ſixty pound weight, diſſolve eight ounces of alum, and work the worſted on ſticks very quick for the ſpace of half an hour at a boiling heat; then take it up, and add to the ſame liquor three or four pounds of copperas, and work it at a boiling heat for half an hour longer; while this is performing, the worſted muſt be waſhed, and one pail full of logwood chips muſt be boiled in another copper about twenty minutes; the worſted muſt then be turned very quick in the logwood decoction about half an hour, when it muſt be taken out, and returned about ten or fifteen minutes in the decoction of alum and copperas, as at firſt. This laſt operation is abſolutely neceſſary, as it contributes much to the beauty and luſtre of the colour, by diſcharging the groſs particles of the logwood, and leaves a beautiful raven grey. This proceſs will hold good for thin goods and coarſe cloth, but a leſs proportion of logwood will do.

CHAP. V.

OF SAXON BLUE AND GREEN.

I Place here among the leſſer dyes that called Saxon blue and green, which has been for ſome time greatly in faſhion, being finer and brighter than any blue or green hitherto known either in the greater or leſſer dye, but it bears no proof, and in twelve days expoſition to the ſun, it loſes a great part of its colour.

Blue on Cloth, Stuff, or Yarn.

Put into a glazed earthen-pot four pounds of good oil of vitriol, with twelve ounces of choice indigo, very finely ground and ſifted; ſtir this chymical mixture very haſtily and frequently in order to excite a fermentation, and break the lumps with a ſtick whoſe bark has been ſtript off. It is cuſtomary with ſome Dyers to put into this compoſition a little antimony or ſaltpetre, tartar, chalk, alum, or other things; but I find it ſufficient to mix the oil and indigo alone, and the colours will be finer, for thoſe neutral ſalts deſtroy the acid of the vitriol and ſully the colour. In twenty-four hours it is fit for uſe; then a copper of a good ſize is to be filled with fair water, (into which one peck of bran is put in a bag) and made pretty warm; the bran, after yielding its flour, muſt be taken out, and the chymic mixed well with water, in a piggin, is put in according to the ſhade required, having firſt put in a handful of powdered tartar; the cloth, &c. is to be well wet, and worked very quick over the wynch for half an hour. The liquor muſt be not be made hotter than that for madder red. Obſerve, the hot acid of the vitriol would cauſe the blue to incline to green if too much heat was given. The cloth, ſtuff, or yarn muſt be turned in this liquor very quick for half an hour, and having been previouſly very well ſcoured, the colour will be brilliant and fine; it is beſt after waſhing to dry this colour in the ſhade.

Chymic for Green.

Eight ounces of indigo is ſufficient for four pounds of oil for green, becauſe this mixture works green (and would even dye a pea-green if uſed very hot) and therefore would not do for blue. The indigo is better ſuſpended in this mixture than in the former, and is ſuppoſed to go further in green. The goods being well ſcoured are to be alumed; for every twenty pound weight, two pounds of alum is to be put into a copper with fair water, and the goods boiled gently an hour and a half; whilſt this is performing, another copper is got ready, in which fuſtic chips are put to boil; if there are any to dye pea-green it is beſt to dye them firſt, not as practiſed in ſome dye-houſes, for this great reaſon, that when ſeveral parcels of goods have been through the ſame liquor, there remains a ſcurf which the acid extracts, and that is ſure to ſtick to the next parcel that goes in; and if pea-green was the laſt, the colour would be dulled thereby. The greens (pea-green excepted) are to be turned about ten minutes in the alum liquor after they are dyed, in order to clear them of the ſtuff, and render the colour brighter. The alum liquor is not to be hotter than that the hand may be borne in. Obſerve, if the alum was put in (as is cuſtomary in ſome dye-houſes) with the fuſtic, it would retard its working ſo well; for alum, being an acid, would diſcharge if uſed with, as well as prepare for fuſtic.

The reader will perhaps think me too tedious in this proceſs, and ſay (becauſe he is not uſed to this method) it is a ſuperfluous work; but be aſſured that the time loſt in the proceſs will be ſaved in the fuſtic, if attention is paid.

CHAP. VI.

OF BRAZIL WOOD.

UNDER the general name of Brazil wood is comprehended that of Fernambouc, St. Martha, Japan, and ſome others which I ſhall not here diſtinguiſh, ſince they are all uſed after the ſame manner for dying. Some give greater variety of colours than others, or finer; but this often proceeds from the parts of the wood being more or leſs expoſed to the air, or that ſome parts of it may be rotted. The ſoundeſt or higheſt in colour are to be choſen for dying.

All thoſe woods give a tolerable good colour, either uſed alone, mixt with logwood, or with other colouring ingredients. It has been ſhown, that, in the falſe or baſtard violet, a little Brazil was added to the logwood; but in the vinous greys, or thoſe which have a caſt of the red, a great deal more is uſed. Sometimes only, a ſmall quantity of galls is put with the Brazil, and it is ſaddened with copperas; often alſo with logwood, archil, or ſome other ingredient, it is added according to the ſhade, from whence it is not poſſible to give any fixt rule for this kind of work, on account of the infinite variety of ſhades which are obtained from theſe different mixtures.

The natural colour of the Brazil, and for which it is moſt uſed, is the falſe ſcarlet, which appears fine and bright, but far inferior to the brightneſs of the cochineal or gum lacque.

To extract the colour from this wood, the hardeſt water, ſuch as will not diſſolve ſoap, muſt be made uſe of for river water has not nearly ſo good an effect; it muſt be cut into chips and boiled for three hours; the water is then taken out and put into a large veſſel, and freſh well-water put on the wood and boiled again for three hours; this water is added to the firſt.

This liquor, which is called juice of Brazil, muſt be old and fermented, and rope like an oily wine before it is fit for uſe. To extract a bright red from it, the ſtuff muſt be filled with the ſalts of the common liquor of preparation, but the alum muſt predominate, for the tartar alone, and alſo ſour water, greatly ſpoils the beauty of this colour: in ſhort, acids are hurtful to it, and diſſolve its red colouring part. Four ounces of alum for each pound of ſtuff is to be added to the liquor, and only two ounces of tartar, or even leſs. The wool is to be boiled in it for three hours; it is then taken out and gently wrung, and thus kept moiſt for eight days at leaſt, that by the ſalts being retained it may be ſufficiently prepared to receive the dye. To dye with this, one or two pails full of the old juice of Brazil is put into a convenient copper, and well ſcummed. Dip the ſtuff which has remained eight or ten days moiſtened in the preparing liquor, and it muſt be well worked in it without making the liquor boil too ſtrongly, until it be ſmoothly and equally dyed. Care muſt be taken to wring a corner of this ſtuff now and then, as I have already ſaid, to judge of its colour, for, whilſt wet, it appears at leaſt three ſhades deeper than when dry. By this method, which is ſomewhat tedious, very bright reds are made, perfectly imitating certain colours the Engliſh ſell under the name of Campeachy ſcarlets, which, by the proof of dyes, are not found to be better than this, only that they ſeem to have been lightly maddered.

This red, of which I have given the proceſs, and which is no where elſe deſcribed, withſtands the weather three or four months in the winter, without loſing any of its ſhade; on the contrary, it ſaddens, and ſeems to acquire a ground, but it does not ſtand the proof of tartar.

Some Dyers of the grear dye uſe Brazil to heighten the red of madder, either to ſave this root, or make its red more bright than uſual. This is done by dipping in a Brazil liquor a ſtuff, begun with the madder, but this kind of fraudulent dye is expreſsly forbid by the French regulations, as well as any mixture of the great dye with the leſſer, becauſe it can only ſerve to cheat, and to paſs for a fine madder red, a colour which in a few days loſes all its brightneſs along with the ſhade, which has been drawn from the Brazil, prepared in the common manner.

The firſt colour extracted from this wood is not of a good dye, probably becauſe it is an indigeſted ſap, and whoſe colouring particles have not been ſufficiently attenuated to be retained and ſufficiently fixt in the pores of the wool dyed in it. When theſe firſt groſs parts of the colour have been carried off, thoſe that remain in ſmall quantity are finer, and mixing themſelves to the yellow parts, which are furniſhed by the pure woody parts, the red reſulting from it is more laſting.

By the means of acids, of what kind ſoever, all the red colour of this wood is carried off or diſappears; then the ſtuff that is dyed by it takes a hind colour, more or leſs deep in proportion to the time it is kept in the liquor, and this colour is of a very good dye.

It is ſaid that the Dyers of Amboiſe have a method of binding the Brazil colour in this manner; after their ſtuffs lightly maddered have been paſſed through a liquor of weld, and conſequently boiled twice in alum and tartar, they put arſenic and pearl-aſhes in the juice of Brazil, and it is aſſerted that this colour then reſiſts the proofs; I tried this proceſs, but it did not ſucceed.

When a very bright red is required from the Brazil, I know by experience that it is poſſible to inſure the colour drawn from it after ſuch a manner that, having expoſed it thirty days to the rays of the ſummer's ſun, it will not change; but theſe kind of colours are coffee and cheſnut purples.

To make theſe, I keep the ſtuff moiſtened in its liquor in a cellar for fifteen days; this liquor is prepared as for the reds, of which I have heretofore ſpoken; I fill a copper to two thirds with well water, and the remaining third up with Brazil juice, to which I add about one ounce of Aleppo galls in very fine powder to every pound of ſtuff, and then boil it one or two hours, as I want the ſhade to be in deepneſs: the ſtuff is aired from time to time, and when it has taken the colour deſired, it is well cooled before it is waſhed. This ſtuff being bruſhed, the nap layed, and cold-preſſed, comes out very fine and very ſmooth.

CHAP. VII.

OF FUSTIC.

THE fuſtic gives an orange colour that is not laſting; it is commonly uſed in the leſſer dye, like the roots or huſks of walnuts, without boiling the ſtuff, ſo that it is eaſily managed. It is often mixed with walnut huſks and weld, to make tobacco and cinnamon colours, and other like ſhades. But this wood is a very bad ingredient, for its colour being expoſed to the air for a very ſhort time loſes all its brightneſs and the greateſt part of its yellow ſhade.

If a ſtuff dyed with fuſtic is dipt in the woad vat, a diſagreeable olive enſues, which does not reſiſt the air, but ſoon loſes its colour.

I have already ſaid that fuſtic was made uſe of in Languedoc for making of lobſter colours for foreign markets, as it greatly ſaves cochineal. For this purpoſe they mix weld, fuſtic, and cochineal, with a little cream of tartar, in the ſame liquor, and the ſtuff boiled in this liquor comes out of a lobſter colour, and accordingly, to the quantity of theſe different ingredients, it becomes more or leſs red, tending to the orange. Although the method of mixing together ingredients of the good with thoſe of the leſſer dye ought to be condemned, yet in this caſe, and for this colour only, which is in conſiderable demand in the Mediterranean, it appears that the fuſtic may be tolerated; for having attempted to make the ſame colour, with only the ingredients of the good dye, I did not get a more laſting colour.

The change which the air produces in the lobſter colour made with fuſtic is very ſenſible, but it is not ſo diſagreeable as the changes incident to ſeveral other colours; for all the ſhade goes off and weakens at once, ſo that it is rather a diminution than a change of colour; whereas the lobſter colour made with the yellow wood becomes of a cherry colour.

CHAP.

CHAP. VIII.

OF ROUCOU.

THE roucou or racourt is a kind of dry paſte brought from America; this ingredient gives an orange colour pretty near the ſame as the fuſtic, and the dye is not more laſting. However it is not by the proof alum that the quality of the roucou is to be judged, for this does not in the leaſt alter its colour; on the contrary, it becomes finer and brighter, but the air carries it off, and effaces it in a ſhort time; ſoap has the ſame effect, and it is by this it muſt be tried according to the inſtructions on theſe kind of proofs. The place of this ingredient is eaſily ſupplied in the good dye by weld and madder mixt together, but roucou is made uſe of in the leſſer dye after the following manner.

Pearl-aſhes are diſſolved in a copper with a ſufficient quantity of water; it is well boiled for one hour, that the aſhes may be totally diſſolved; then as many pounds of roucou as there are of aſhes, are added; the liquor is well raked and ſuffered to boil for a quarter of an hour; the wool or ſtuffs that are to be dyed are then dipt without any preparation, except dipping them in luke-warm water, that the colour may ſpread itſelf equally.

They are left in this liquor, working them continually until they are come to the deſired ſhade, after which they are waſhed and dried.

The roucou is often mixt with other ingredients of the leſſer dye, but I cannot give any inſtructions on theſe mixtures, as they depend on the ſhades you wiſh to make, and are in themſelves attended with no difficulty.

I have boiled the ſtuff in alum and tartar before I dyed it with roucou, but though the colour was more laſting it was not ſufficiently ſo to be deemed of the good dye. On the whole, the roucou is a very bad ingredient for dying of wool, and is not made much uſe of, for it is dear, and other ingredients, that are cheaper and hold better, are uſed in its ſtead.

Wool dyed with roucou, and afterwards dipt in the indigo or woad vat, takes a reddiſh olive, which in a very ſhort time becomes almoſt blue in the air, the colour given by the roucou diſappearing.

CHAP. IX.

OF THE GRAINS OF AVIGNON.

THE grains of Avignon are but little uſed in dying, they give a pretty good yellow, but not laſting, no more than the green, produced by dipping in the ſame liquor a ſtuff that has a ground of blue. To work it, the ſtuff muſt be boiled in alum and tartar as for weld. Then a freſh liquor is made with theſe grains, and the ſtuff is dipt, and muſt lie in it longer or ſhorter, according to the ſhade that is wanted. There is no difficulty in working of it, ſo I need only obſerve that it ought never to be uſed but when all other ingredients for dying yellow are wanting; this muſt ſeldom happen, as they are neither ſcarce nor dear.

CHAP. X.

OF TURMERIC.

THE turmeric is a root that is brought from the Eaſt Indies; that which comes from Patna is moſt valued. The Indian Dyers call it *haleli*; it is alſo called *concome* in the regulations of M. Colbert. It is reduced to a very fine powder, and uſed pretty near the ſame way as the grain of Avignon, but in much leſs quantity, on account of its yielding a great deal of dye. It is ſomewhat better than the other yellow ingredients ſpoken of in the preceding chapter, but, as it is dear, it is a ſufficient reaſon for ſeldom or never uſing it in the leſſer dye.

It is ſometimes uſed in the great dye to gild the yellows made with weld, and to brighten and orange the ſcarlets; but this practice is to be condemned; for the air carries off all the colour of the turmeric in a ſhort time, ſo that the gilded yellows return to their firſt ſtate, and the ſcarlets brown conſiderably; when this happens to theſe ſort of colours, it may be looked on as certain that they have been falſified with this ingredient, which is not laſting.

I omit ſpeaking of ſaffron, which may alſo be made uſe of to dye yellow, but which I believe is not uſed; firſt, on account of its being dear; and ſecondly, becauſe its yellow is ſtill worſe than thoſe of the two preceding ingredients.

This is all that remains for me to ſay on the ingredients of the leſſer dye, they are only to be uſed for common and low-priced ſtuffs. It is not that I think it impoſſible to extract laſting colours from them, but then thoſe colours will not ſtrictly be the ſame which theſe ingredients yield naturally, or by the ordinary methods, as that gum and aſtriction which is wanting in them muſt be added, and then they are no more of the ſame quality; conſequently the rays of light will be differently reflected, and the colour will be different.

CHAP. XI.

OF SILVER GREY.

FOR pearl colour or ſilver grey, to dye forty pounds of woollen cloth or worſted, boil in a ſmall copper four pounds of logwood chips for half an hour, add to it ſix ounces of pearl-aſhes, and mix them well together; while this is performing, (having the worſted well ſcoured and parcelled in hanks on the dye-ſticks) heat a great copper with clean water, and put one peck of wheat bran in a bag into the copper; let it remain with often ſtirring about an hour; when the water begins to boil, put in three ounces of alum, which will throw the filth of the water to the top, when it muſt be taken off with the bowl; waſh the worſted in this liquor about forty minutes, when it muſt be taken up, and three or four pails of the logwood liquor added to the alum water. The goods muſt then be worked very quick for forty minutes, when you may add more logwood liquor if you ſee occaſion. Great care muſt be taken after waſhing to dry this colour in the ſhade, or it will perhaps change.

Some dye this colour in one liquor, and boil the logwood in a bag. This proceſs is leſs tedious, but I prefer the former. It will be well for the Dyer to take notice, that if too great quantity of alum or aſhes are uſed herein, the colour will be imperfect; for the alum, if uſed in a right proportion, gives that bloom to the good which is neceſſary for a pearl; if too much, the contrary would happen. The aſhes alſo, if uſed in too great quantity, would make the colour too red; this may ſeem a contradiction, becauſe the aſhes are in alkali, but but practice will teach the truth.

Another excellent Silver Dye.

For twenty pounds weight of cloth or worſted, eight ounces of alum and twelve pounds of fenugreek muſt boil with the goods half an hour; then take it up, and add one pound of pearl-aſhes and eight ounces of Brazil wood; boil them gently with the goods half an hour; rince it and you have a beautiful colour.

INSTRUCTIONS

ON THE PROOF OF

DIED WOOL AND WOOLLEN STUFFS.

AS it has been found that the methods preſcribed for the proof of dyes, by the thirty-ſeventh article of the French regulations for the Dyers in the good dye, of cloth, ſerges, and other woollen ſtuffs made in 1669, and by article 220 of the general inſtructions for the dying of wool of all colours, and for the culture of drugs and ingredients therein uſed made in 1671, were inſufficient for an exact judgment of the goodneſs or falſity of ſeveral colours, that they might ſometimes lead into error, and leave room for diſputes, different experiments have been made by the French king's order on wool deſigned for the manufacture of tapeſtry to aſcertain the degree of goodneſs of each colour, and the moſt convincing proofs of each.

For this purpoſe, fine wool was dyed in different colours both in the great and leſſer dye, and expoſed to the air and ſun during a proper time; the good colours kept themſelves perfectly, and the falſe ones were carried off more or leſs according to their bad quality; and as a colour is only to be accounted good inaſmuch as it reſiſts the action of the air and ſun, this proof ſerved as a rule to decide the goodneſs of different colours.

After this, ſeveral proofs were made on the ſame wool whoſe patterns had been expoſed to the air and ſun, and it was immediately found that the ſame trials could not be indifferently uſed in proving of all colours; for it often happened that one colour, known to be good by expoſition to the air, was conſiderably changed by the eſſay proof, and that a falſe colour ſtood the ſame proof.

Theſe experiments exploded lemon juice, vinegar, ſour waters, and ſtrong waters, as it was impoſſible to aſcertain the degree of acidity of theſe liquors; and it appeared that the ſureſt method is to uſe ingredients with common water, whoſe effects are always equal.

In following this plan, it has been judged neceſſary to divide into three claſſes all the colours in which wool is dyed, either in the great or leſſer dye, and to fix the ingredients that are to be made uſe of in the eſſay proofs of the colours, comprehended in each of theſe three claſſes.

The colours comprehended in the firſt claſs are to undergo the proof of Roman alum, thoſe of the ſecond with white ſoap, and thoſe of the third with red tartar.

But it is not ſufficient to be aſſured of the goodneſs of a colour by uſing in the proof, ingredients whoſe effect may always be equal; it is alſo neceſſary, that not only the duration of this trial be exactly determined, but even the quantity of water fixed; for the proportion of water conſiderably augments or diminiſhes the activity of the ingredients which are put into it. The method of proceeding in theſe different proofs ſhall be ſet forth in the following articles:

ARTICLE I.

The proof of Roman Alum muſt be made as follows:

One pound of water and half an ounce of alum are to be put in an earthern veſſel or pan. The veſſel is to be placed on the fire, and when the water boils ſtrongly, the wool is put in and left to boil for five minutes, after which it is to be taken out and waſhed in cold water; the weight of the pattern of wool muſt be a drachm or thereabouts.

II.

When ſeveral patterns are to undergo the proof together, the quantity of water and alum is to be doubled, or even trippled, which will no ways change the ſtrength or effect of the proof, if you obſerve the ſame proportion of water and alum, ſo that for each pound of water there may be one ounce of alum.

III.

To render the effect of the proof more certain, care muſt be taken not to try together wool of different colours.

IV.

The Proof with White Soap is to be made after the following Manner.

To one pound of water add two drachms of white ſoap, and place the veſſel on the fire; ſtir it with a ſtick that the ſoap may be thoroughly diſſolved; when it is ſo, and the water boils ſtrongly, the woollen pattern is put in, which is to boil for five minutes.

V.

When ſeveral patterns are to undergo this proof, the ſame method is to be obſerved as in the ſecond article, that is, to put to each a pound of water two drachms of ſoap.

VI.

The proof with red tartar muſt be exactly the ſame, with the ſame proportions as the proof with alum, taking care that the tartar is finely powdered and well diſſolved in the water before the pattern is put in.

VII.

The following colours are to be proved with Roman alum, viz. crimſon of all ſhades, Venetian ſcarlet, flame colour or common ſcarlet, cherry colour and other ſhades of ſcarlet, violets and *gris-de-lin* of all ſhades, purples, lobſter, pomegranate, ſlate greys, lavender greys, violet greys, vinous greys, and all other like ſhades.

VIII.

If, contrary to the orders of the regulations on dying, any ingredients of the falſe dye have been made uſe of for fine wool dyed in crimſon, the cheat will be eaſily found out by the proof of alum, for it changes the fine crimſon a little on the violet, that is, makes it border a little on the *gris-de-lin*, but it deſtroys the higheſt ſhades of the baſtard crimſon; thus this proof is a ſure method to diſtinguiſh falſe crimſon from fine.

IX.

Scarlet of kermes or grain, commonly called Venetian ſcarlet, is no wiſe prejudiced by this proof; it raiſes the fire-colour ſcarlet to a purple, and gives a violet colour to the lighter ſhades, ſo that they border on the *gris-de-lin*, but it carries off the greateſt part of the falſe Brazil ſcarlet, and brings it to an onion-peel colour; it has yet a more ſenſible effect on the lighter ſhades of this falſe colour.

The ſame proof carries off almoſt entirely the ſcarlet of flock and its ſhade.

X.

Though the violet is not a ſimple colour, but formed of blue and red ſhades, it is nevertheleſs of ſo much conſequence as to merit a particular inquiry.

The ſame proof with Roman alum has ſcarcely any effect on the fine violet, whereas it conſiderably alters the falſe; but it muſt be obſerved, that it does not always equally carry off a great part of the ſhade of the falſe violet, becauſe this colour has ſometimes a ground of woad or indigo: now this ground being of the good dye, is not carried off by the proof, but the redneſs goes off, and the brown ſhades become almoſt blue, and the pale ones of the colour of lees of wine.

XI.

With regard to half fine violets, forbidden by the preſent regulations, they muſt be ranked in the claſs of falſe violets, and do not ſtand the proof.

XII.

The fine *gris-de-lin* may be known from the falſe by the ſame method, the difference is but trifling; the *gris-de-lin* of the good dye loſes a little leſs than that of the falſe.

XIII.

Fine purples entirely reſiſt the proof with alum, whereas the falſe entirely loſe the greateſt part of their colour.

XIV.

Lobſter colours and pomegranate ſtrike on the purple after the proof, if they have been made with cochineal, whereas they will pale greatly if fuſtic has been uſed; the uſe of which is prohibited.

XV.

Blues of the good dye will loſe nothing in the proof, whether of woad or indigo; but thoſe of the leſſer dye will loſe the greateſt parr of their colour.

XVI.

The ſlate greys, lavender greys, violet greys, and vinous greys, loſe almoſt all their colour if they are of the falſe dye; whereas they perfectly maintain it, if of the good.

XVII.

XVII.

The proofs of the following colours are to be made with white ſoap; yellow, jonquill or lemon colour, orange, and all the ſhades of yellow; all green ſhades from the yellow green or light green, to the cabbage or parrot green, the reds of madder, cinnamon, tobacco, and ſuch like.

XVIII.

This proof perfectly ſhows if the yellows and other ſhades derived from it are of a good or falſe dye; for it carries off the greateſt part of their colour if they have been made with grains of Avignon, roucou, turmeric, fuſtic, or ſaffron, whoſe uſe is prohibited for fine dyes, but it no ways impairs the yellows made with ſavory, Dyers' wood, yellow wood, weld, or fenugreek.

XIX.

The ſame proof will alſo ſhow the goodneſs of greens, as thoſe of the falſe dye loſe moſt of their colour, or become blue if they have a ground of woad or indigo; whereas thoſe of the good dye loſe almoſt nothing of their ſhade, but remain green.

XX.

The reds of pure madder loſe nothing by the ſoap proof, on the contrary become finer, but if Brazil wood has been uſed, they loſe their colour in proportion to the quantity of it in the compoſition of the dye.

XXI.

Cinnamon, ſnuff colours, and others of this caſt, are ſcarcely altered by this proof, if of the good dye, but they loſe conſiderably if roucou, fuſtic, or diſſolved flock has been made uſe of.

XXII.

The proof of alum would be of no uſe, and might even lead us into errors with regard to ſeveral colours belonging to this ſecond claſs, for it no ways alters the fuſtic nor the roncou, which nevertheleſs do not withſtand the action of the air; on the other hand, it carries off a great part of the ſavory and of the Dyers' wood, which are very good yellows and greens.

XXIII.

All the brown or root colours ſhould undergo the proof with red tartar. The Dyers call by this name all colours that are not derived from the five primary colours; they are made with rinds and roots of walnut, alder-bark, ſumach or roudoul, ſantal and ſoot; each of theſe ingredients gives a great variety of ſhades, which are all comprehended under the general name of brown or root colour.

XXIV.

The above-named ingredients in the preceding article are good, except the ſantal and ſoot, which are not quite ſo good, and make the wool ſtiff when too great a quantity is uſed, ſo that all this proof can ſhow on theſe kind of colours, is, whether too much ſantal or ſoot has been put into them; in this caſe they loſe conſiderably by the proof with tartar; but if made with other ingredients, with only a moderate quantity of ſantal or ſoot, they ſtand a great deal better.

XXV.

XXV.

Black is the only colour which cannot be comprehended in any of the three claſſes above-mentioned, and a much more active proof muſt be made uſe of. To know if the wool has had a deep ground of blue, conformable to the regulations, the proof is to be made in the following manner: take a pint or pound of water, one ounce of tartar, and the ſame quantity of Roman alum well powdered; boil it, and then put in the pattern; let it boil ſtrongly for a quarter of an hour, and afterwards waſh it in cold water; you will then eaſily know if it has had the proper blue ground, for if ſo, the wool will remain of a dark blue almoſt black; if not, it will turn very grey.

XXVI.

It is common to brown certain colours with galls and copperas; this operation is called browning, which is to be permitted in the good dye; but as this may cauſe a particular effect in proving of theſe colours, it is to be obſerved that although the proof liquor appears loaded with dye as the browning is carried off, the wool muſt be reputed of a good dye if it ſtill preſerves its ground; if on the contrary it loſes it, it is then deemed to be of the falſe dye.

XXVII.

Although the browning, which is made of galls and copperas, if of the good dye, yet, as it hardens the wool, it is better to make uſe of the indigo or woad vat in preference.

XXVIII.

XXVIII.

Common greys made with galls and copperas are not to undergo any of theſe proofs, becauſe theſe colours are of the good dye, and are not otherways made; but it is to be obſerved, that they are firſt to be paſſed through the liquor of galls, and afterwards through a ſecond liquor, containing the copperas, which muſt be much cooler than the firſt, for by this method they are made finer and more laſting.

THE
DYER's ASSISTANT.

PART III.

ADDITIONAL ARTICLES.

CHAP. I.

OF FLOWERS.

AMONG the infinite variety of colours which glow in the flowers of plants, there are very few which have any durability, or whoſe fugitive beauty can be arreſted by art, ſo as to be applied to any valuable purpoſes. The only permanent ones are the yellow. The red, the blue, and all the intermediate ſhades of purples, crimſons, violets, &c. are extremely periſhable. Many of theſe flowers loſe their colour on being barely dried; eſpecially if they are dried ſlowly, as has been uſually directed, in a ſhady and not warm place. The colours of all of them periſh, on keeping, even in the cloſeſt veſſels. The more haſtily they are dried, and the more perfectly they are ſecured from the air, the longer they retain their beauty. The colouring matter, extracted and applied on certain bodies, is ſtill more periſhable: oftentimes it is changed or deſtroyed in the hands of the operator.

Of Blue Flowers.

The colour of many blue flowers is extracted by infuſion in water, but there are ſome from which water gains only a reddiſh or a purpliſh hue. Of thoſe that have been tried, there is not one which gives any blue tincture to ſpirituous liquors: ſome give no colour at all, and ſome a reddiſh one. The juice preſt out from the freſh flowers is for the moſt part blue.

The blue juices and infuſions are changed red by all acids; the marine acid ſeems to ſtrike the moſt florid red The flowers themſelves, macerated in acid liquors, impart alſo a deep red tincture. Alkalis, both fixt and volatile, and lime water, change them to a green. Thoſe infuſions or juices, which have nothing of the native colour of the flower, ſuffer the ſame changes from the addition of acid and alkaline liquors; even when the flowers have been kept till their colour is loſt, infuſions made from them acquire ſtill a red colour from the one, and a green from the other, though in a leſs degree than when the flowers were freſh.

The red colour produced by acids is ſcarcely more durable than the original blue; applied upon other bodies, and expoſed to the air, it gradually degenerates into a faint purpliſh, and at length diſappears, leaving hardly any ſtain behind. The green produced by alkalis changes to a yellow, which does not fade ſo ſoon. The green by lime water is more permanent and more beautiful. Green lakes, prepared from theſe flowers by lime water, have been uſed as pigments by the painter.

The flowers of cyanus have been greatly recommended, as affording elegant and durable blue pigments; but I have never been able to extract from them any blue colour at all. They retain their colour indeed, when haſtily dried, longer than ſome other blue flowers, but they communicate nothing of it to any kind of menſtruum. Infuſions of them in watery, ſpirituous, and oily liquors, are all more or leſs of a reddiſh caſt, without any tendency to blue. Alum, which is ſaid to heighten and preſerve their blue colour, changes it like that of other blue flowers, to a purpliſh red; acids to a deep red; alkalis and lime water to a green.

Solution of tin, added to the watery infuſion, turns it to a fine crimſon; on ſtanding, a beautiful red fecula ſubſides, but it loſes all its colour by the time it is dry. The watery infuſion, inſpiſſated to the conſiſtence of an extract made with rectified ſpirit, is of a purpliſh colour. The colour of both extracts, ſpread thin and expoſed to the air, quickly fades.

The flowers employed in theſe experiments were thoſe of the common blue bottle of the corn-fields; *cyanus ſegetum C. B. centaurea calycibus ſerratis; foliolis linearibus integerrimis; inſimis dentatis linn. ſpec.*

Red Flowers.

Red flowers readily communicate their own red colour to watery menſtrua; among thoſe that have been tried there is not one exception. Thoſe of a full red colour, give to rectified ſpirit alſo a deep red tincture, brighter, though ſomewhat paler than the watery infuſion; but the lighter red flowers, and thoſe that have a tendency to purpliſh, impart very little colour to ſpirit, and ſeem to partake more of the nature of the blue flowers than of the pure red.

Infuſions of red flowers are ſuppoſed to be heightened by acids, and turned green by alkalis, like thoſe of the blue; but this is far from being univerſal. Among thoſe I have examined, the roſe colours and purpliſh reds were all changed

nearly

nearly in the ſame manner as the blues, but th full deep reds were not. The deep infuſion of re poppies is turned by alkalis, not to a green but t a duſky purple.

Yellow Flowers.

The colours of yellow flowers, whether pale o deep, are in general durable. Many of them ar as much ſo perhaps as any of the native colours o vegetables. The colour is extracted both by wate and by ſpirit; the watery infuſions are the deepeſt Neither acids nor alkalis alter the ſpecies of colour, though both of them vary its ſhades; acids rendering it paler, and alkalis deeper: alum likewiſ conſiderably heightens it, though not ſo much a alkalis.

Wool or ſilk impregnated with a ſolution o alum and tartar, receives, on being boiled with the watery infuſion, or decoction, a durable yellow dye, more or leſs deep according as the liquor i more or leſs ſaturated with the colouring matter.

An infuſion of the flowers made in alkaline ley, precipitated by alum, gives a durable yellow lake. Some of theſe flowers, particularly thoſe of the chryſanthemum, or corn-marigold, appear (from the *Ars Tinctora Fundamentalis*, publiſhed by *Stahl*) to be made uſe of by the German Dyers.

In ſome of the deep reddiſh yellow, or orange-coloured flowers, the yellow matter ſeems to be of the ſame kind with that of the pure yellow flowers, but the red to be of a different kind from the pure red ones: watery menſtrua take up only the yellow and leave the red, which may afterwards be extracted by rectified ſpirit of wine, or by water actuated with fixed alkaline ſalt. Such particularly are the ſaffron-coloured flowers of carthamus. Theſe, after the yellow matter has been extracted by water, are ſaid to give a red tincture to ley;

from which, on ſtanding at reſt for ſome time, a deep bright red fecula ſubſides, called, from one of the names of the plant which produces it, ſafflower, and from the countries whence it is commonly brought to us, Spaniſh red, and China lake; this pigment impregnates ſpirits of wine with a beautiful red tincture, but communicates no colour to water.

I have endeavoured to ſeparate by the ſame treatment, the red matter of ſome of the other reddiſh yellow flowers, as thoſe of the garden marigold, but without ſucceſs. Plain water extracted a yellow colour, and alkaline ley extracted afterwards only a paler yellow; though the digeſtions were continued till the flowers had loſt their colour, the tinctures were no other than yellow, and not ſo deep as thoſe obtained from the pure yellow flowers.

The little yellow floſculi, which in ſome kinds of flowers are collected into a compact round diſc, as in the daiſy and corn-marigold, agree ſo far as they have been examined with the expanded yellow petala. Their colour is affected in the ſame manner by acids, by alkalis, and by alum, and equally extracted by water and by ſpirit.

But the yellow farina or fine duſt lodged on the tips of the ſtamina of flowers, appears to be of a different kind. It gives a fine bright yellow to ſpirit, and a duller yellow to water; the undiſſolved part proving, in both caſes, of a pale yellowiſh white. Both the watery and ſpirituous tinctures were brightened by alkaline liquors, turned red by acids, and again a deep yellow on adding more of the alkali. I know no other vegetable yellow that is changed red by acids.

White Flowers.

White flowers are by no means deſtitute of colouring matter. Alkaline lixivia extract from ſome of them a green tincture, and change their colourleſs expreſſed juices to the ſame colour. But I have not obſerved that they are turned red by acids. The flowers of the common wild convolvulus or bind-weed, which in all their parts are white, give a deep yellow or orange tincture to plain water, which, like the tinctures of flowers which are naturally of that colour, is rendered paler by acids, heightened a little by alum, and more conſiderably by alkaline ſalts. The vapours of the volatile vitriolic acid, or of burning ſulphur, which whiten or deſtroy the colour of the coloured flowers, make no change in the white.

CHAP. II.

OF FRUITS.

THE red juices of fruits, as red currants, mulberries, elder berries, and Morello and black cherries, &c. gently inſpiſſated to dryneſs, diſſolve again almoſt totally in water, and appear nearly of the ſame red colour as at firſt. Rectified ſpirit extracts the tinging particles, leaving a conſiderable portion of mucilaginous matter undiſſolved: and hence the ſpirituous tincture proves of a brighter colour than the watery. The red ſolutions and the juices themſelves are ſometimes made dull, and ſometimes more florid, by acids, and generally turned purpliſh by alkalis.

The colours of theſe juices are for the moſt part periſhable. They reſiſt indeed the power of fermentation, and continue almoſt unchanged after the liquor has been converted into wine. But when the juice is ſpread thinly on other bodies, exſiccated, and expoſed to the air, the colour quickly alters and decays: the bright lively reds change the ſooneſt. The dark, dull red ſtain from the juice of the black-cherry, is of conſiderable durability.

The fruit of the American opuntia, or prickly pear, the plant upon which the cochineal inſect is produced, is perhaps an exception: this bright red fruit, according to *Labat*, gives a beautiful red dye. Some experiments, however, made upon the juice of that fruit, as brought into England, did not ſeem to promiſe any great advantage from it; but the particulars I cannot now recollect.

The ripe berries of buckthorn ſtain paper of a green colour. From theſe is prepared the ſubſtance called ſap-green, a pigment ſufficiently durable, readily ſoluble in water, but not miſcible with oil. The berries dried whilſt green, and macerated in alum-water, are ſaid to yield a yellow pigment; and when they have grown over-ripe, ſo as to fall off ſpontaneouſly, a purple one. Woollen cloth, prepared with alum and tartar, receives, on being boiled with the berries, a periſhable yellow dye. The French berries, or grained Avignon of the French Dyers, one of the moſt falſe, that is, the moſt periſhable of the yellow dyes, is the berry of a ſpecies of buckthorn ſmaller than that which grows wild among us.

It is ſaid that the berry of the *Heliotropium tricoccum*, which grows wild about *Montpelier*, ſtains paper of a green colour, and that this green turns preſently to a blue: that the common blue paper receives its colour from this juice: and that the red rags, called *turnſol*, employed for colouring wines and other liquors, are tinctured by the ſame juice, turned red by acids. According to *M. Niſſolle* of the French academy of ſciences (as quoted by Savary in his *Dictionaire de Commerce)* the colouring juice is obtained, not from the berries, but from the tops of the plant, gathered in Auguſt, ground in mills, and then committed to the preſs. The juice is expoſed to the ſun about an hour, the rags dipped in it, dried in the ſun, moiſtened by the vapour which ariſes during the ſlacking of quick-lime with urine, then dried again in the ſun, and dipped again in the juice. The Dutch and others are ſaid to prepare turnſol rags, and turnſol in the maſs, from different ingredients, among which archil is a principal one.

In ſome plants, peony for inſtance, the ſeeds at a certain point of maturity are covered with a fine ſhining red membrane; the pellicles of the ſeeds of a certain American tree afford the red maſſes brought into Europe under the names of annotto, orlean, and roucou. The red ſeeds, cleared from the pods, are ſteeped in water for ſeven or eight days or longer, till the liquor begins to ferment; then ſtrongly ſtirred, and ſtamped with wooden paddles and beaters, to promote the ſeparation of the red ſkins; this proceſs is repeated ſeveral times till the ſeeds are left white. The liquor paſſed through cloſe cane ſieves is pretty thick, of a deep red colour, and a very ill ſmell. In boiling it throws up its colouring matter to the ſurface in form of ſcum, which is afterwards boiled down by itſelf to a due conſiſtence, and made up, while ſoft, into balls.

The annotto commonly met with among us, is moderately hard and dry, of a brown colour on the outſide, and a dull red within. It is with difficulty acted on by water, and tinges the liquor only of a pale browniſh yellow colour. In rectified ſpirit of wine it readily diſſolves, and communicates a high orange or yellowiſh red. Hence it is uſed as an ingredient in varniſhes, for giving more or leſs of an orange caſt to the ſimple yellows. Alkaline ſalts render it perfectly ſoluble in boiling water, without altering its colour. Wool or ſilk boiled in the ſolution, acquire a deep but not a very durable orange dye. Its colour is not changed by alum or by acids any more than by alkalis; but when imbibed in cloth, it is diſcharged by ſoap, and deſtroyed by expoſure to the air.

Mr. Pott, in the Berlin memoirs for the year 1752, mentions a very extraordinary property of this concrete. "With the vitriolic acid, it pro-"duces a blue colour, of extreme beauty, but with "this capital defect, that all ſalts and liquors, "even common water, deſtroy it." The ſpecimen of annotto which I examined, was not ſenſibly acted on by ſpirit of vitriol. It received no change in its own colour, and communicated none to the liquor. Nor did any viſible change enſue upon dropping the acid into tinctures of annotto made in water or in ſpirit.

Labat informs us, that the Indians prepare an annotto greatly ſuperior to that which is brought to us, of a bright ſhining red colour, almoſt equal to carmine; that for this purpoſe, inſtead of ſteeping and fermenting the ſeeds in water, they rub them with the hands previouſly dipt in oil, till the pellicles come off, and are reduced into a clear paſte, which is ſcraped off from the hands with a knife, and laid on a clean leaf in the ſhade to dry. *De Laeet*, in his notes on Marcgrave's Natural Hiſtory of Brazil, mentions alſo two kinds of annotto, one of a permanent crimſon colour, (coccineus) uſed as a fucus; and another which gives a colour inclining more to that of ſaffron. This laſt, which is our annotto, he ſuppoſes to be a mixture of the firſt ſort with certain rezinous matters, and with the juice of the root of the tree.

Ximenes relates, that annotto with urine ſtains linen of ſuch a permanent colour that it can never be waſhed out. Perhaps the firſt ſort is meant. Our annotto boiled in urine, imparted to linen a deep yellowiſh red: the ſtained linen, hung out in the air in ſummer, in ſeven or eight days loſt all its colour and became white again.

CHAP.

CHAP. III.

OF LEAVES.

THE green colour of the leaves of plants is extracted by rectified ſpirit of wine and by oils. The ſpirituous tinctures are generally of a fine deep green, even when the leaves themſelves are dull coloured, or yellowiſh, or hoary. The colour however ſeldom abides long even in the liquor; much leſs when the tinging matter is ſeparated in a ſolid form, and expoſed with a large ſurface to the air. The editor of the *Wirtemberg Pharmacopœia* obſerves, that the leaves of acanthus, brankurſine or bears-breech, give a more durable green tincture to ſpirit than thoſe of any other herb. Alkalis heighten the colour both of the tinctures and green juices. Acids weaken, deſtroy, or change it to a browniſh. Lime water improves both the colour and the durability. By means of lime, not inelegant green lakes are procurable from the leaves of acanthus, lilly of the valley, and ſeveral other plants.

There are very few herbs which communicate any ſhare of their green colour to water; perhaps none that give a green of any conſiderable deepneſs. It is ſaid, however, that the leaves of ſome plants give a green dye to woollen, without the addition of any other colouring matter; particularly thoſe of the wild chervil or cow-weed (*Myrrhis ſylveſtris ſeminibus lævibus, C. B*) the common ragwort, and devil's bit. The proceſs with this laſt, as deſcribed by *Linnæus* (in the *Svenſca Acad. Handle. ärs,* 1742) is pretty remarkable. The peaſants, he informs us in ſome of the Swediſh provinces, ſtratify the freſh leaves with woollen yarn, and boil them about as long as it is cuſtomary to boil fiſh.

The whole is ſuffered to ſtand in the veſſel for a night. The wool, taken out in the morning, does not appear to have received any colour. The pot is again made hot, and the yarn hung over it upon a ſtick, covered with an inverted diſh to confine the ſteam, for this ſteam is ſuppoſed to be eſſential to the colour. The yarn is afterwards wrung, the leaves taken out of the boiling liquor, a little freſh water added to the decoction, and the wool frequently dipt therein, till it appears ſufficiently coloured.

The leaves of many kinds of herbs and trees give a yellow dye to wool or woollen cloth that has been previouſly boiled with a ſolution of alum and tartar: weld in particular affords a fine yellow, and is commonly made uſe of for this purpoſe by the Dyers, and cultivated in large quantities in ſome parts of England. There is no colour for which we have ſuch plenty of materials as for yellow. Mr. Hellot obſerves in his *Art de Teindre*, that all leaves, barks, and roots which on being chewed diſcover a ſlight aſtringency, as the leaves of the almond, peach, and pear-trees, aſh-bark, (eſpecially that taken off after the firſt riſing of the ſap in ſpring) the roots of wild patience, &c. yield durable yellows, more or leſs beautiful according to the length of time that the boiling is continued, and the proportions of alum and tartar in the preparatory liquor: that a large quantity of alum makes theſe yellows approach to the elegant yellow of weld: that if the tartar is made to prevail, it inclines them to an orange: that if the roots, barks, or leaves be too long boiled, the yellow proves tarniſhed, and acquires ſhades of brown: that for dying with weld, the beſt proportions of the ſalts are, four parts of alum and one of tartar to ſixteen of the wool: and that the wool prepared with theſe is to be boiled again with five or ſix times its quantity of weld: that for light ſhades, it is cuſtomary to diminiſh the alum and omit the tartar; and that in this caſe the colour is more ſlowly imbibed, and proves leſs durable.

Of all the colours of the Dyer, we have the feweſt materials for blue; the mineral and animal kingdoms afford none, excepting perhaps Pruſſian blue, which Mr. Macquer has lately attempted to introduce in this art. The vegetable yields but two, which are both produced from the leaves of plants, indigo and woad.

CHAP. IV.

MR. LEWIS'S HISTORY OF MADDER, AND MANNER OF TREATING IT.

MADDER (*Rubia tinctorum ſativa, C. B.*) is one of the aſperifolious ſtellated plants, or of thoſe which have rough narrow leaves, ſet in form of a ſtar at the joints of the ſtalks. The root, which is the only part made uſe of, is long and ſlender, of a red colour both on the outſide and within, excepting a whitiſh pith which runs along the middle.

This plant was formerly cultivated among us in great quantity for the uſe of the Dyers, who for ſome time paſt have been ſupplied from Holland and Zealand. Its culture is now again ſet on foot in this kingdom, under the laudable encouragement of a public ſociety. Madder is not like alkanet, and other exotic plants, the colour of which degenerates in our climates, for Engliſh madder is equal to the beſt that is brought from abroad.

Madder root gives out its colour both to water and to rectified ſpirit; the watery tincture is of a dark dull red, the ſpirituous of a deep bright one. Taken internally (for it has ſometimes been uſed medicinally as an aperient and diuretic) it tinges the urine red. In the Philoſophical Tranſactions, and in the Memoirs of the French Academy, there are accounts of its producing a like effect upon the bones of animals, to whom it had been given with their food. All the bones, particularly the more ſolid ones, were changed both externally and internally to a deep red, but neither the cartilaginous nor fleſhy part ſuffered any alteration. Some of thoſe bones, macerated in water for many weeks together, and afterwards ſteeped and boiled in ſpirit of wine, loſt nothing of their colour, nor communicated any tinge to the liquors.

The dealers in this commodity make three ſorts of it; madder in the branch, madder in the bunch or in the bundle, and madder unbundled.

Madder in the branch is the entire root dried. This ground in mills to a groſs powder is the unbundled madder. The bundled or bunch madder is a powder of the finer roots, freed from the outer bark and from the pith. It is ſaid that by keeping for two or three years in cloſe caſks the colour is improved; in open veſſels it decays.

Madder imparts to woollen cloth, prepared with alum and tartar, a very durable, though not a very beautiful red dye. As it is the cheapeſt of all the red drugs that give a durable colour, it is the principal one commonly made uſe of for ordinary ſtuffs. Sometimes its dye is heightened by the addition of Brazil wood; and ſometimes it is employed in conjunction with the dearer reds, as cochineal, for demi-ſcarlets and demi-crimſons. Mr. Hellot informs us, that thoſe who dye the beſt madder reds are particularly careful to keep the liquor of a heat conſiderably below boiling, increaſing the fire only towards the end, ſo as to make it boil for a minute or two juſt before the cloth is taken out to confirm the dye; a boiling heat enables water to extract not only the red, but a tawny or browniſh matter, which debaſes the red to a dull brick colour.

The proportion of madder is about half the weight of the cloth. The beſt proportion of ſalts for preparing the cloth to receive the dye, ſeems to be five parts of alum and one of red tartar for ſixteen of the ſtuff; which is to be boiled with theſe for two hours or longer, then kept moiſt for ſome days, and afterwards digeſted with the madder.

A variation in the proportion of the ſalts, varies the colour communicated by the madder, and not only the ſhade, but the ſpecies of colour.

If the alum be diminiſhed, and the tartar increaſed, the dye proves a red cinnamon; if the alum be entirely omitted, the red is deſtroyed, and a very durable tawny cinnamon is produced.

On boiling the dyed cloth in weak alkaline ley, great part of the colour is deſtroyed, and the remainder appears of a dirty or a kind of ſallow hue. Solution of ſoap, on the other hand, diſcharges a part, and leaves the remaining red more lively than before.

Volatile alkalis heighten the red colour of madder, but at the ſame time render it fugitive like themſelves. Madder prepared with lime and urine, after the manner practiſed for archil, loſt its red colour on attempting to dye with it, and communicated to the cloth only permanent nut-colours.

If a pure red, as that of cochineal, be applied on cloth which has been previouſly dyed blue, and afterwards prepared for receiving this red by boiling with alum and tartar, a purple or violet will be produced, according as the blue or the red prevail. The madder red has not this effect, for as its colour is not a pure red, but is tarniſhed by the tawny matter which its woody fibres have in common with other roots, it gives upon blue only a cheſnut dye, more or leſs deep according to the deepneſs of the blue applied firſt.

There are, however, means of obtaining from madder a fine purple, without the addition of any other colouring drug. A piece of white woollen cloth, weighing half an ounce, was boiled for half an hour with ten grains of Roman alum and ſix grains of cryſtals of tartar, and then taken out, ſqueezed, and ſuffered to cool. Twenty-four grains of bunch madder were added to the ſame liquor; and after the madder had given out its colour, twenty drops of a ſolution of biſmuth (made in ſpirit of nitre, diluted with equal its weight of water) were dropped in. The cloth was now dipped again, and in half an hour taken out, ſqueezed, and waſhed. It appeared of a crimſon colour, nearly as beautiful as if it had been dyed with cochineal. To try the effect of loading it further with the colouring matter, it was returned into the liquor and boiled for a quarter of an hour longer: it had now acquired a purple colour ſufficiently vivid.

On varying this experiment by keeping the cloth moiſt for ſome days after the preparation with alum and tartar, then dipping it in a plain decoction of madder made as uſual without ſalts, and adding, when it had gained a bright cinnamon colour, the ſame ſolution of biſmuth, the dye inſtead of purple proved only a cheſnut.

CHAP. V.

OF FUSTIC.

FUSTIC is the wood of ſpecies of mulberry-tree, growing in Jamaica and Brazil, called by *Sir Hans Sloane*, *Morus Fructu Viridi Ligno Sulphureo Tinctorio*. It is of a deep ſulphur yellow colour, which it readily gives out both to water and ſpirit. The watery decoction dyes prepared woollen of a very durable orange yellow: the colour is imbibed by the cloth in a moderate warmth without boiling.

The fuſtet or fuſtel of the French is a yellow wood or root very different from our fuſtic. It gives a fine orange dye to woollen, but the colour is extremely periſhable in the air. The plant grows wild in Italy and Provence, and is cultivated with us in gardens on account of the beauty of its flowers. It is called *Venice ſumach*, *cotinus cotiaria*, *coccigria*; *cotinus matthioli*, *C. B.*

CHAP. VI.

NEPHRITIC WOOD.

THIS wood is brought from the eaſtern countries in large pieces, covered with a dark blackiſh bark. The wood is hard, heavy, compact, of a fine grain, of a whitiſh or pale yellow colour on the outſide, and a duſky reddiſh brown in the heart. Of the tree we have no very certain account.

This wood, particularly the outer pale part, gives out both to water and to rectified ſpirit a deep tincture appearing, when placed between the eye and the light, of a golden colour; in other ſituations, blue. Hence it is named by *Caſpar Bauhino*, *lignum peregrinum*, *aquam cœruleam redden*.

By this mark it is eaſily diſtinguiſhed from pieces of a different kind of wood, which are ſometimes mixt with it, and which give only a yellow tincture to water.

It is remarkable, that the blue colour of the infuſion of nephritic wood is deſtroyed by acids, the liquor after the admixture of theſe appearing in all ſituations yellow; and that the addition of alkalis, either of the fixt or volatile kind, in quantity ſufficient to neutralize the acid, reſtores the blueneſs. No other woody matter is known that gives any degree of blue tincture, and no other vegetable blue is known that is thus deſtructible by acids.

This wood is at preſent rarely met with in the ſhops; nor is it applied to any uſe, except that ſome have employed it medicinally, and expected from it *diuretic virtues*, whence its name *nephritic wood*.

CHAP. VII.

MR. FERGUSON'S HISTORY OF LOGWOOD AS A COLOURING DRUG.

LOGWOOD or Campeachy-wood (*Lignum Brazilo-ſimile, cæruleo tingens, J. B.*) is the wood of a low prickly tree, which grows plentifully about Campeachy or the Bay of Honduras, and has of late been introduced into ſome of the warmer of the Britiſh plantations, particularly Jamaica. It is a native of the low marſhy places. The wood comes over in pretty large logs, cleared from the bark. It is very hard, compact, heavy, and of a red colour.

Logwood gives out its colour both to watery and ſpirituous menſtrua, but not readily to either. It requires to be raſped and ground into fine powder, and boiled in ſeveral freſh parcels of the liquors. Rectified ſpirit extracts the colour more eaſily, and from a larger proportion of the wood than water does.

The tinctures both in water and in ſpirit are of a fine red, with an admixture, particularly in the watery one, of a violet or purple. Volatile alkaline ſalts or ſpirits incline the colour more to purple. The vegetable and nitrous acids render it pale, the vitriolic and marine acids deepen it.

The watery decoction, wrote with on paper, loſes its redneſs in a few days and becomes wholly violet. This colour it communicates alſo to woollen cloth previouſly prepared by boiling with a ſolution of alum and tartar. The dye is beautiful, but very periſhable. It is often uſed by the Dyers as an ingredient in compound colours, for procuring certain ſhades which are not eaſily hit by other materials.

With chalybeate ſolutions it ſtrikes a black. Hence it is employed in conjunction with thoſe liquors for ſtaining wood black for picture frames, &c. and with the addition of galls, for dying cloth and hats black. The black dyes in which this wood is an ingredient, have a particular luſtre and ſoftneſs, far beyond thoſe made with vitriol and galls alone. The beauty however which it here imparts is not permanent, any more than its own natural violet dye.

On the ſame principle it improves alſo the luſtre and blackneſs of writing-ink. Ink made with vitriol and galls does not attain to its full blackneſs, till after it has lain ſome time upon the paper. A due addition of Logwood renders it of a deep black as it flows from the pen, eſpecially when vinegar or white wine is uſed for the menſtruum.

Decoctions and extracts made from logwood have an agreeable ſweetiſh taſte, followed by a ſlight aſtringency. They have lately been introduced into medicine, and given with ſucceſs in caſes where mild reſtringents are required. They often tinge the ſtools, and ſometimes the urine of a red colour.

CHAP. VIII.

THE PROCESS OF PRUSSIAN BLUE.

PRUSSIAN blue is prepared by precipitating a ſolution of green vitriol and alum with a lixivium drawn from fixed alkaline ſalt that has been calcined with animal coals. Commonly about three parts of alkali and two of dried ox-blood are calcined ſo long as any flame appears, then thrown into boiling water, and the ſtrained decoction poured into a hot mixture of ſolutions of four parts of alum and one or leſs of vitriol. The liquor becomes inſtantly thick or curdly, and looks at firſt of a greyiſh colour, which changes to a brown and in a little time to a bluiſh green. The matter, being well ſtirred together, and mixed with a quantity of hard ſpring water, a green precipitate ſubſides: ſpirit of ſalt poured upon the edulcorated powder diſſolves a part, and leaves the reſt blue.

Mr. Geoffrey is the firſt who has given any plauſible theory of this proceſs, or any rational means for improving it. He obſerves, that the Pruſſian blue is no other than the iron of the vitriol, revived by the inflammable matter of the alkaline lixivium, and perhaps brightened by an admixture of the white earth of alum; that the green colour proceeds from a part of the yellow ferrugineous calx or ochre unrevived, mixing with the blue, and that the ſpirit of ſalt diſſolves this ochre more readily than the blue part, though it will diſſolve that alſo by long ſtanding, or if uſed in too large quantity. From theſe principles he was led to increaſe the quantity of inflammable matter, that there might be enough to receive the whole of the ferrugineous ochre, and produce a blue colour at once without the uſe of the acid ſpirit. In this he perfectly ſucceeded, and found at the ſame time that the colour might be rendered of any degree of deepneſs or lightneſs at pleaſure.

If the alkali is calcined with twice its weight of dried blood, and the lixivium obtained from it, poured into a ſolution of one part of vitriol, to ſix of alum, the liquor acquires a very pale blue colour, and depoſits as pale a precipitate. On adding more and more of a freſh ſolution of vitriol, the colour becomes deeper and deeper, almoſt to blackneſs,

blackneſs. He imagines with great probability, that the blue pigment thus prepared will prove more durable in the air, mingle more perfectly with other colours, and be leſs apt to injure the luſtre of ſuch as are mixed with, or applied to its neighbourhood, than that made in the common manner; the tarniſh and other inconveniences to which the common Pruſſian blue is ſubject, ſeeming to proceed from the acid and ſpirit, which cannot be totally ſeparated by any ablution.

He takes notice alſo of an amuſing phænomenon which happens upon mixture. When the liquors are well ſtirred together, and the circular motion as ſoon as poſſible ſtopt; ſome drops of ſolution of vitriol (depurated by long ſettling) let fall on different parts of the ſurface, divide, ſpread, and form curious repreſentations of flowers, trees, ſhrubs, flying inſects, &c. in great regularity and perfection. Theſe continue ten or twelve minutes, and on ſtirring the liquor again, and dropping in ſome more of the ſolution of vitriol, are ſucceeded by a new picture.

Mr. Macquer has ingeniouſly applied the preparation of this pigment to the dying of wool and ſilk, and found means of fixing the blue fecula in their pores. By dipping cloth firſt in a diluted ſolution of vitriol and alum, then in the ley diluted, and afterwards in water accidulated with ſpirit of vitriol, it acquires a light blue colour, which becomes deeper and deeper on repeating the dippings alternately in the ſame order as before; adding to the liquors each time a little more of the reſpective ſaline matters. The blue dye, he ſays, in beauty and luſtre exceeds that of indigo and woad, as far as ſcarlet does the madder red, and penetrates the whole ſubſtance of fulled cloth without weakening it. The colour is durable in the air, and ſtands boiling with alum water, but is diſcharged

charged by ſoap, and, without certain precautions, liable to be ſpecky or unequal. See the Memoirs of the French Academy for the year 1749.

CHAP. IX.

ALKANET-ROOT.

THE roots of alkanet in many reſpects very much reſemble ſaunders wood, but differ from it remarkably in others. They impart an elegant deep red to pure ſpirit of wine, to oils, to wax, and to unctuous ſubſtances: I do not know of any red drug that tinges oil of ſo fine a colour. To water they give only a dull browniſh red. The ſpirituous liquor, on being inſpiſſated to the conſiſtence of an extract, inſtead of preſerving its fine red like that of ſaunders, changes to an unſightly brown.

Volatile ſpirits have been ſaid to gain from this root a beautiful violet or amethyſt colour; but I have not found that they extract any colour but a dull reddiſh brown.

The alkanet plant is a ſpecies of bugloſs, named by Tournefort, *bugloſſum radice rubra, ſive anchuſa vulgatior floribus cæruleis.* It is a native of the warmer parts of Europe, and cultivated in ſome of our gardens. The greateſt quantities are raiſed in Germany and France, particularly about Montpelier, from whence we are chiefly ſupplied with the roots.

The alkanet root produced in England is much inferior in colour to that brought from abroad; the former being only lightly reddiſh, the latter of a deep purpliſh red. This has induced ſome to ſuſpect that the foreign roots owe part of their colour to art, but a chymical examination teaches otherwiſe. The colouring matter is found upon experiment, to be of the ſame kind in both, and to differ in ſeveral of its properties from that of all the other known red drugs; ſo that no artifice appears to be practicable without diſcovery, unleſs it was concentrating the colour of two roots into one, or ſuperſaturating one root with the colour extracted from another.

The principal uſe of alkanet-root is for colouring oils, unguents, lip-ſalves, plaiſters, &c. Wax tinged with it, applied on warm marble, ſtains it of a fleſh colour, which ſinks deep into the ſtone. The ſpirituous tincture gives a deep red ſtain.

The colour of this root is confined to the cortical part, the pith being whitiſh; hence as the ſmall roots have more bark in proportion to their bulk than the large ones, thoſe alſo contain moſt colour.

CHAP. X.

OF ALUM.

NATURE produces no perfect alum, but affords the materials for it in ſundry ores, pyritœ, ſtones, ſlates, earths, waters, and bitumens, as pit-coal. Some late experiments by Mr. Geoffrey and Mr. Pot have ſhown that the earth of alum is contained in clay, and that a true alum may be prepared by digeſting clay in the vitriolic acid. Both theſe gentlemen imagine that only a particular part of the clay is here extracted.

Whether it exiſted originally in the clay, poſſeſſed of the ſame properties which it is found to have when extracted, or whether it has ſuffered a change in the operation, they have not determined. From the experiments I have made, the latter ſeems to be the caſe. Powdered tobacco-pipe-clay, being boiled in a conſiderable quantity of oil of vitriol, and the fire continued to dryneſs, the matter, examined when grown cold, diſcovers ſcarcely any taſte, or only a ſlight acidulous one. On expoſure to the air for a few days, the greateſt part of it is found changed into lanuginous efflореſcences in taſte exactly like alum: the remainder treated with freſh oil of vitriol in the ſame manner, exhibits the ſame phænomena, and this repeatedly, till nearly the whole of the clay is converted into an aſtringent ſalt.

If the earth be ſeparated again from the acid, (by diſſolving the ſalt in water, and precipitating with any alkaline ſalt) it is now found to diſſolve with eaſe in every acid; to form with the vitriolic alum again; with the nitrous, a compound reſembling alum in taſte; with the vegetable acids, a ſubſtance leſs aſtringent and leſs ungrateful.

CHAP. XI.

CHYMICAL HISTORY OF SAUNDERS, AND ITS DIFFERENCE FROM OTHER RED-WOODS.

RED ſaunders is a hard, compact, ponderous wood, of a dark blackiſh red on the outſide, and a light red colour within; of no particular ſmell or taſte. It is brought from the Coromandel coaſt and from Golconda. Of the tree we have no certain account. Its principal uſe is as a colouring drug. Thoſe whoſe buſineſs it is to raſp and grind it into powder, probably employ certain ſaline or other additions to improve the colour; whence the remarkable differences in the colour of powdered ſaunders prepared in different places. That of Straſburgh is of the deepeſt and livelieſt red. Some ſorts are of a dead dark red, and ſome of a pale brick red; ſome incline to purple or violet, and ſome to brown.

The colour of this wood reſides wholly in its reſin, and hence is extracted by rectified ſpirit, whilſt water, though it takes up a portion of mucilaginous matter, gains no tinge, or only a ſlight yellowiſh one. From two ounces of the wood were obtained by ſpirit of wine three drachms and a half of reſinous extract, and afterwards by water, a ſcruple of mucilage. By applying water at firſt, I obtained from two ounces two drachms and ſix grains of a tough mucilaginous extract, which could not eaſily be reduced to dryneſs. The remainder ſtill yielded, with ſpirit, two drachms of reſin. The indiſoluble matter weighed, in the firſt caſe, an ounce and a half and fifteen grains; in the latter, nineteen grains leſs. Neither the diſtilled water nor ſpirit had any remarkable taſte or ſmell.

The red colour of ſaunders appears to be no other than a concentrated yellow, for by bare dilution it becomes yellow. A grain of the reſinous extract, diſſolved in an ounce of rectified ſpirit, tinges it red, but this ſolution, mixt with a quart of freſh ſpirit, gives only a yellow hue. Hoffman reports that this reſin does not give a tincture to any kind of oil. I have tried five oils, thoſe of amber, turpentine, almonds, anniſeeds, and lavender. It gave no colour to the two firſt, but a deep red to the laſt, and a paler red to the other two.

CHAP. XII.

OF VERDIGRISE.

IT may not be amiſs to give the reader a chymical hint of verdigriſe.

Vegetable acids diſſolve copper ſlowly, but in conſiderable quantity; the ſolution ſhoots into bluiſh green cryſtals, ſimilar to the verdigriſe, *ærugo* or *viride æris*, of the ſhops. This preparation is made in large quantities in France, particularly about Montpelier, by ſtratifying copper-plates with the huſks of grapes remaining after the juice has been preſt out. Theſe ſoon become acid, and corrode the copper.

Verdigriſe ſhould be choſen in cakes, not moiſt or unctuous, but dry, compact, and of an uniform texture, of a lively green colour throughout, as free as poſſible from white and black ſpecks, and ſeeds or ſtalks of the grape. It is purified by ſolution in diſtilled vinegar, and cryſtalization, and then called, improperly, diſtilled verdigriſe or flowers of copper. The Dutch who prepare theſe cryſtals in large quantities, after duly evaporating the ſolution, ſet it to ſhoot, not, as is cuſtomary, in a cold but in a warm place, as practiſed in making ſugar-candy.

If rectified ſpirit of wine be added to the ſolution, or if volatile alkalis be added to a ſolution of copper and ſpirit of wine to this mixture, ſmall blue chryſtals will be immediately formed. Theſe are called by ſome antepileptic cryſtals of copper.

Highly rectified ſpirit of wine, digeſted on half an ounce, or twelve ſcruples of powdered verdigriſe, diſſolved three ſcruples and a half; ordinary rectified ſpirit, four ſcruples; common malt ſpirits, four and a half, and French brandy ſeven and a half. Water diſſolved, out of the ſame quantity, five ſcruples. Common wine vinegar diſſolved all but fifteen grains, and diſtilled vinegar, all but ten grains. The whole quantity of verdigriſe diſſolved in either kind of vinegar, could not be recovered again in a cryſtaline form.

From the common vinegar only two ſcruples and five grains cryſtalized, and from the diſtilled vinegar three ſcruples. The reſiduum in the firſt caſe continued ſoftiſh, in the latter dry. With French brandy there was no cryſtalization at all; the whole that the ſpirit had taken up remaining uniformly mixt into the conſiſtence of an extract.

A
HINT
TO THE
Dyers and Cloth-Makers,
AND WELL WORTH THE NOTICE OF
THE MERCHANT.

By JAMES HAIGH,

LATE SILK AND MUSLIN-DYER, LEEDS.

PREFACE.

THE Author of the Dyer's Assistant thinks it his duty, in gratitude to the profeſſors in that noble art, to ſubſcribe his hearty thanks for their approbation of, and encouragement given to that work, in this and every part of England. It is well known my deſign is not to teach ſtrangers to dye; but to help the thinking part of the Dyers to improve; and to ſhow them how I ſpend ſome of my leiſure hours to help them, as well as myſelf, to a moſt neceſſary knowledge. It is well known by that body of people, and felt too by ſome, that the price for dying woollen goods hath been much reduced of late. Many circumſtances having determined me, long ſince, to acquire all poſſible knowledge in the practice of dying, I am therefore conſtrained once more to recommend a ſtrict inquiry into the original quality of all the drugs they uſe, that thereby, if poſſible, they may diſcover ſome of the many hidden advantages that may juſtly be expected therefrom.

I am aſtoniſhed that no artiſt has ever attempted to improve this moſt ingenious art on chymical principles. I begun the work in hopes that my maſter-piece would undertake to improve it, but in vain do I expect it.

A Word to the thinking Part of Dyers.

If you were ſenſible of the double advantage that might be acquired in the uſe of many of your vegetable drugs, which muſt be firſt grounded on chymical experiments in miniature, which will be a certain rule to the practice at large, I am certain you would not reſt till you had made ſome improvement.

If after you have been dying with that reſinous drug, ſaunders, when emptying the veſſel you take up a handful, dry it and digeſt it in a phial with ſome pure ſpirits of wine, and it will afford you an excellent red, water being inſufficient to diſſolve the reſin, and let out the prime part of the colour. Many others may be diſcovered if an unwearied attention was paid.

Many will cenſure and deſpiſe this, for no other reaſon than becauſe they cannot ſee into it; nor will they be at any pains to learn and improve their talents. They ſeem rather to chooſe the old round, like a horſe in a mill, having no ſpirit or courage to improve, but content with each knowing the other's method, without ſtriving to excel, and diſcover more complete and leſs expenſive ways of working, and uſing the drugs to the beſt advantage.

I know not how men can ſit ſtill when there is more to learn. Let it not be ſaid of you, as of one of old, "he lived and died and did nothing;" perhaps he worked with his hands, but his head was aſleep; and therefore he was an unprofitable ſervant, and when dead, his memory was no more. Sure it is, the invitation I have to write and publiſh this ſmall pamphlet is not ſo much to pleaſe others, or to ſhow any thing I have is capable of the name of parts, but to communicate my good wiſhes for improvement to my brethren the Dyers, and to ſhow them my willingneſs to help to perfect one of the moſt uſeful arts in the world.

I ſhall leave all to itſelf, and to every man's juſt liberty to approve, or diſapprove, as he pleaſes. And however it be, the author ſhall not be much troubled, for he is certain no man can have a lighter eſteem for him, than he has for himſelf; who, however, will be beſt pleaſed, if any man ſhall find benefit by what he has wrote. If any ſhould allege a general acceptation, that, to the author, will be no prevailing argument; for the multitude, though moſt in number, are the worſt and moſt partial judges. He does not plead the importunity of friends for the publication of this. If it is worthy, it needs no apology; if not, let it be deſpiſed; and I remain the ſame friend to trade.

JAMES HAIGH.

A HINT TO THE DYERS, &c.

BLACK being a primitive colour, and one of the moſt difficult to perfect, deſerves a few remarks. If I aſk a Dyer what ingredients compoſe a black, the anſwer will be this: Logwood, ſhumac, bark, and copperas; and if he knows it, he will add a little aſhes and argol in the laſt wet. If I aſk him which of theſe drugs contain an acid, which an alkaline, and which a neutral quality, he cannot give me an anſwer: ſo you ſee he knows the effect, but a ſtranger to the cauſe, and every elſe thing ſeparate from fact and cuſtom.

What a pity it is that men will not ſearch things to the bottom, when they might be able to find out the cauſe of miſcarriages, for which goods are frequently thrown aſide to be dyed other colours, greatly to the Dyer's loſs. In converſing with a ſenſible Dyer, I ſimply aſked him, What part does logwood act in the black dye? the honeſt man as ſimply anſwered, "It helps to make it black." No other proof was wanted to know that he alſo followed his forefathers in the old round. But the reader, by now, thinks it time to be informed of the buſineſs of logwood; which is (if uſed in a right proportion) to ſoften the goods, and give luſtre to the colour. Logwood being poſſeſſed of a moſt excellent aſtringent quality, fixes itſelf in the pores of the goods, and gives them a velvet-like feel and gloſs.

Some will object to this aſſertion, and ſay, but our blacks have not that velvet-like feel and gloſs. True, Sir, but don't you know the reaſon? you dye your blacks without ſcouring, forgetting, or not knowing, that when the goods enter the boiling dye-liquor, they grow harſh, and the oil contained in them forms a ſort of reſin, which becomes as fixed as if it was pitch or tar. This is one great cauſe why blacks are ſo liable to ſoil and dirty linen, becauſe the dye is in ſome ſenſe held in an outſide or ſuperficial ſtate. Think then, is it poſſible theſe goods ſhould finiſh ſoft like velvet, or ſhine like a raven's feather? No, on the contrary they ſpoil the preſs papers, and come out ſtiff and hard like buckram, (not velvet) and are often three-parts periſhed in the finiſhing. No greater cauſe can be aſſigned for it than that of not ſcouring. This is the reaſon of the great difference, ſo much ſpoken of, between the London blacks and thoſe dyed at Leeds. If the Leeds Dyers would take the ſame pains as the Londoners do, I think they would excel, in fact, if not in name.

The finiſhing ſhops in London are not more than half ſo well furniſhed with tools as thoſe at Leeds are; and therefore let the Leeds Dyers be equally tight and clean in their performance, and there is nothing to prevent their ſuperiority. But the maſter Dyers give a very reaſonable anſwer to the foregoing. They ſay, the price is too low, and they cannot afford to take ſo much pains. What a pity that the merchants do not conſider this! if threepence a piece was added to the price for dying thin goods black, it would about pay for the ſcouring, and the goods would be finiſhed with a brilliant luſtre, and yet ſoft like a ruſſel.

I ſhould ſpeak a little to the nature and buſineſs of the other drugs, which enter the compoſition of black, had I not done it before, (*ſee the article black, Dyer's Aſſiſtant, p.* 146.)

I am aſtoniſhed at the ignorance of the poor cloth-makers, many of whom have applied to me frequently for inſtructions; one of them, on being aſked what ſort of ware, and how much he uſed to dye ſuch a colour, ſhowing him a pattern, he anſwered, When I have a pattern given me by a merchant, I go to the ſalter, ſhew him the order, and he ſerves me with what is wanted. I converſed with him ſome time, and would have inſtructed him, but alas! he had left his capacity at home, and I might as well have read the newspaper to him. What a pity it is that ſo many hundreds of that noble branch of buſineſs work, as it were, blindfolded, and poverty bitten too, for want of inſtructions, which they have no ſpirit to ſeek; who, when they bring a cloth to the market, are glad to ſell it for one and ſixpence, or two ſhillings in the pound profit, when they might as eaſily gain five or ſix ſhillings, if they knew how to uſe their drugs. But I deſpair of doing that for them, which nature has left undone; for, without I could teach them to ſee with a Dyer's eye, I might talk and write for ever in vain.

But there is another claſs of cloth-makers, to whom I will give a uſeful hint, and have done.

The article ſky-blue deſerves our notice. This colour is often ſubſtituted, (even on fine cloth) by the Saxon blue, on account of its brilliancy and fine luſtre; but, like a fugitive, it only ſtays for a ſeaſon. A little experience has taught me, that if a parcel of fine wool be well ſcoured, then ſulphured or ſtoved, than which nothing can make it whiter, and then dyed in a weak vat, it will have all the beauty of the Saxon blue, without its imperfections. The vat uſed for this purpoſe ſhould be ſet with a ſmall quantity of indigo, on purpoſe for light ſhades, when the ſhades will be always brighter than when dyed in an old vat that has been weakened by dying dark colours. But the Dyers tell you that blues bear ſo low a price, and indigo is ſo dear, that they cannot afford to ſet freſh vats for light ſhades. Here is a ſufficient cauſe, and one very great reaſon of retarding the perfection of many colours. If the wool beforementioned ſhould be obſtructed in the milling, by means of the ſulphur, (of which I have not had experience) I would commend the dying of the wool after ſcouring only, and ſtove it after it is milled, which I think will anſwer the ſame purpoſe; and the beauty of the colour will amply pay for every ſuperfluous work.

I would recommend to the Dyers, after waſhing the dark blues well at the river, to turn the cloth very quick through a warm veſſel of water, in which has been diſſolved a little alum, and they will ſee a ſurpriſing change in the luſtre from that ſimple proceſs.

I am not willing to omit any thing worth notice in the courſe of my experiments. I will, therefore, lightly touch the properties of common water. By a great number of experiments, I am thoroughly convinced, that different waters with the ſame ingredients ſtrike different colours. I find that the pureſt and lighteſt waters ſtrike the beſt light colours.

All the dye-houſes at a diſtance from the river in London are furniſhed with wood ciſterns which hold perhaps from one to two hundred hogſheads of water, which is ſupplied from the water works, and is always impure, and frequently muddy; when on ſtanding a conſiderable time, as is the caſe at ſome ſeaſons of the year, it becomes putrid and emits a fœtid ſmell; if ſuffered to ſtand longer, it purifies itſelf, and becomes ſweet and clear, as well as conſiderably lighter. I have ſometimes filled a veſſel when the water has been all of a ferment, and ſtunk almoſt beyond bearing, which at a boiling heat was no more felt; by adding a handful of common ſtarch and a ſmall bit of alum, all the filth is made to riſe, and is taken off with a ladle for that purpoſe. The ſuperior goodneſs of the water obliges us to aſcribe an advantage to the London Dyers of light colours; add to this their remarkable cleanlineſs. When a veſſel is boiling they watch it carefully; and with a mop, kept for that purpoſe, they rub off the ſcum all round at the water's edge, ſo that the liquor is perfectly clear.

A ſhort Remark on the Dye of Brazil wood.

It is impoſſible to wear a red, a dove colour, a crimſon, purple, light or deep violet, or any other colour, the produce of Brazil wood uſed recently many weeks, without fading, ſpotting, or ſoiling. If theſe colours were dyed in grain they would indeed coſt ſomething more, but you have then a colour which will continue beautiful as long as the ſtuff or cloth will laſt; and if ſpotted with dirt or greaſe, can eaſily be ſcoured and cleaned without danger of loſing or injuring the colour.

I boiled fifty pounds of Brazil chips one hour, in a copper of the hardeſt ſpring water I could find, and carefully took off the ſcum, turned this liquor over into a large tub, and re-heated the copper to boil the chips a ſecond time, when the colour was all extracted. I then put both liquors together, and let it ſtand ſix months, when it was ropy and thick like oil. Now having prepared a ſmall piece of fine cloth in alum and ſour bran-water, and kept it moiſt five days unwaſhed out of the alum, I boiled one nut-gall and one quart of Brazil liquor ten minutes, then rinſed my piece of cloth, and dyed it a very beautiful marone. But the chief remark I intend to make here, is, that I hung this piece of cloth in the open air night and day during four ſevere winter months, and it had rather gained in beauty of colour, and was grown rather deeper. This is a ſufficient proof that chymiſtry hath a power of ſecuring the fine particles of thoſe vegetables which are now called baſtard drugs. Experiments (which are the beſt guides in natural philoſophy, as well as in arts) plainly ſhow that a great advantage might ariſe in favour of the ſtudious practitioner, who is not wearied if he miſs his deſign after twenty or thirty trials, but ſtill purſues his plan till he has hit it; for nothing of the kind ſeems to be impoſſible.

A few Experimental Obſervations on the Dye of Cochineal.

After all the common proceſſes of dying with cochineal, there is found at the bottom of the veſſel a deep brown ſediment. This ſediment appears to conſiſt of the impurities of the tartar, and the groſſer parts of the powdered cochineal. This being lightly waſhed with clear cold water, dried and ground on a marble, with one fourth its weight of fine tartar, into an impalpable powder, and then put into water with a little alum, a piece of white cloth boiled in this liquor three quarters of an hour acquired a very beautiful crimſon dye.

This experiment evinces, that, by reducing cochineal into a powder of moderate fineneſs as commonly practiſed, we do not gain all the advantage which this valuable commodity is capable of yielding.

If the cochineal, when taken from the veſſel, (after the ſcarlets are dyed) is treated as above, the ſaving in the cochineal, whether for ſcarlet or crimſon, will be about one-third. Though leſs tartar is uſually employed in the dye-liquor, yet this quantity here directed does no harm; it appeared on trial that the colour was rather the more ſolid for it. All urinous and alkaline liquors or ſubſtances ſtain ſcarlet to a crimſon, by deſtroying the effect of the acid. Hence, in pure country air, ſcarlet retains its luſtre much longer than in cities and towns, where alkaline and urinous vapours are more abundant. The dirt of roads and ſundry ſubſtances of the acrid kind, leave no ſtain on ſcarlet, if the part be waſhed immediately in pure water, and wrung in a clean linen cloth. If the dirt is ſuffered to dry, a blackiſh violet ſpot will remain, which can only be diſcharged by mild vegetable acids, as vinegar, citron juice, a warm dilute ſolution of cream of tartar, or ſour bran-water; if theſe acids, however, be not applied with a good deal of addreſs, whilſt they take out the blackiſh ſtain they leave a yellow one, by diſſolving the colouring particles of the cochineal itſelf.

After at leaſt a thouſand experiments, I am obliged to conclude, that the dying of wool is the moſt extenſive branch of this art, it may be conſidered as its baſis; but the dying of ſilk, thread, and cotton, deſerves alſo our attention.

The great difference between thoſe ſubſtances, and that of wool, is well known to the calico printers, whoſe grand care it is to find means of making linen receive the ſame dyes as wool does. The phyſical cauſe of the difference ſeems yet unknown; and indeed, as before obſerved of dyes in general, we know as yet very little. Are animal filaments tubular, and the colouring atoms received within them? are vegetable filaments ſolid, and the colour depoſited on the ſurface? or, does not their different ſuſceptibility of colour depend rather on the different intrinſic properties of the two? An anſwer to this would doubtleſs prove of great utility.

I ſhould be happy to find ſome artiſt undertake to improve what I have in a poor way begun. I long to ſee the art in perfection, one half of which is yet in oblivion.

The reader may be aſſured, that what is here recited is purely the reſult of the author's own experience, (not theory) and part of the effects of many years ſtudy.

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THE END.

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